STATE OF ILLINOIS
DWIGHT H. GREEN, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
FRANK G. THOMPSON, *Director*

DIVISION OF THE
STATE GEOLOGICAL SURVEY
M. M. LEIGHTON, *Chief*
URBANA

REPORT OF INVESTIGATIONS — No. 97

CORALS FROM THE CHOUTEAU AND RELATED FORMATIONS OF THE MISSISSIPPI VALLEY REGION

BY

WILLIAM H. EASTON

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

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ORGANIZATION

Topographic Mapping in Cooperation with the United States Geological Survey.

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INTRODUCTION

A restudy of the Chouteau corals is important for the following reasons.

1. The coral fauna of the Chouteau limestone is larger in number of genera and species than that known from any other Carboniferous formation in this hemisphere.

2. The species are reestablished by critical restudy of the available primary types.

3. The stratigraphic and geographic ranges of the species are established by critical reexamination of previously published records and restudy of specimens. Synonymies have been revised accordingly.

4. Corals are so abundant in the Chouteau limestone that they are definitely useful for correlation.

5. The Chouteau is the oldest formation of undisputed Mississippian age and it is therefore important as a stratigraphic key horizon.

6. Further systematic study will be aided by clarification of inadequately understood genera and species. Some genera whose types came from the Chouteau are known in Europe and the Orient.

7. The opportunity is presented to apply modern systematics to a large number of Lower Mississippian corals.

The writer has studied every available Chouteau coral known by him to be in institutional collections. Material which is unavailable includes that not lent for study by certain distant institutions, that stored away during the uncertain times preceding the war, and that which some institutions have stored away because of lack of space. If specimens are known to have been lost or destroyed these facts are recorded. In all, about 550 specimens have been studied.

The check list included in this study shows the occurrence of each species as determined by the literature. It is to be hoped that detailed collections will be made from the Chouteau limestone (restricted) so that the precise occurrence of the species may be known. To that end this paper is offered as an aid in stratigraphic studies of the Kinderhook group.

The original descriptions of some species are so inadequate or inexact that the species cannot be recognized. Most of the original descriptions require revision and the use of modern morphologic terminology.

Some of the Chouteau genera are known to occur in Europe, Australia, and Asia and a few of them possess such marked peculiarities that reasonable correlation of strata can be made between these distant places. Eventually, perhaps, the coral-bearing Carboniferous beds of America may be closely correlated with the coral zones of western Europe.

Carboniferous corals are of undoubted usefulness in stratigraphic correlation. Their neglect for many years has probably resulted from the generally indispensable necessity of grinding one or more surfaces to ensure identification. As a matter of fact, the grinding of a surface on a coral is commonly easier than the careful preparation of the exterior or interior necessary for the precise study of certain other fossils.

Acknowledgments

Specimens have been lent by: E. B. Branson, of the University of Missouri; Guy Campbell, of Corydon, Indiana; G. Arthur Cooper, of the United States National Museum; Carey Croneis, of the Uni-

versity of Chicago; G. M. Ehlers, of the University of Michigan; Rousseau H. Flower, of the University of Cincinnati; and H. E. Vokes, of the American Museum of Natural History. Winifred Goldring, of the New York State Museum, furnished photographs of specimens and data on occurrence and disposition of specimens. The manuscript has profited through criticisms and suggestions by C. L. Cooper and J. Marvin Weller, of the Illinois State Geological Survey. The writer is grateful to all these people for their cooperation in this study.

Preparation and Illustration

Study of internal structure is generally required for accurate identification of corals. Formerly thin-sections were made, but this elaborate process is usually unnecessary. Generally a flat-ground surface or a specimen sawed in parts and smoothed off will furnish all required data. If well calcified material is available, cellulose peel sections can be made.

Some of the Chouteau corals are illustrated here for the first time and sections of others are presented for the first time. Previously published sections have varied in enlargement but here most of them are shown at a uniform enlargement unless this would entail an unwarranted waste of space or greater enlargement was desirable to bring out detail.

The Chouteau corals are variously calcareous, dolomitic, and silicified, and it has been most convenient to illustrate their internal structure by camera lucida drawings or by inked photographs reduced by use of Farmers solution. The two photographic plates show growth habits, general calical features, and minor structural details.

Primary type specimens of most species have been available for study and they are illustrated either externally or internally or both. If necessary to verify a species, the holotype was sectioned, but otherwise another specimen was used. If possible the calyx was carefully excavated. Thoroughly silicified specimens were etched free with acid.

Taxonomic Procedure

Many of the Chouteau species were based upon groups of cotypes, one specimen of which has now been selected as the holotype in each case. Some of these groups included many specimens and some of them were discovered to contain specimens belonging to several different genera and species. If the cotypes are not all conspecific a specimen has been chosen as holotype which agrees most closely with the common conception of the species even though it was necessary to disregard the specimen figured or described by the original author. Fortunately, the International Rules of Zoological Nomenclature allow a reviser to make such a selection and thus cause the least amount of confusion and do the least damage to existing classification.

As many as possible of the citations listed in the synonymies were reviewed. Some of the anomalies of stratigraphic distribution have resulted from faulty identifications perpetuated by failure of subsequent workers to verify previous work.

STRATIGRAPHIC SUMMARY

The Chouteau limestone in Missouri, as originally defined by Swallow (1855, p. 101), consists of an upper 40- to 50-foot thick-bedded limestone and of a lower 20-foot thin-bedded limestone. The type section at Chouteau Springs, Cooper County, Missouri, was described by Moore (1928, p. 84) as consisting of an upper member 30 feet thick and a lower member 20 feet thick. At a quarry in Sweeney, Cooper County, Moore (1928, p. 85) recorded 43 feet 6 inches of limestone in the upper member, which is separated by a possible disconformity from 25 feet 8 inches of limestone in the lower member. Previous to the appearance of Moore's paper, the upper and lower beds were sometimes distinguished but they were always considered to be subdivisions of a single formation. Moore, however, restricted use of the name Chouteau to the lower beds, of Kinderhook age, and proposed the name Sedalia limestone for the upper beds, which he assigned to the Osage group and correlated somewhat tentatively with the Fern Glen formation. The latter usage is accepted by the United States Geological Survey (Wilmarth, 1938, p. 439).

One mile north of Sedalia, Pettis County, Missouri, Moore (1928, p. 86) recorded 18 feet 2 inches of Sedalia limestone overlying 6 feet 5 inches of exposed Chouteau limestone. Many of the original Chouteau collections were made from the quarries near Sedalia.

In the river bluffs at Providence, Boone County, Missouri, Moore (1928, p. 88) recorded 21½ feet of Sedalia limestone and 42¾ feet of Chouteau limestone. Many fossils have been collected from this locality.

Some 25 miles southwest of St. Louis a good exposure contains about 7 feet of Chouteau limestone, according to McQueen (1939, p. 97), who referred higher sandy shales and cherty limestones at that place to the Sedalia which he considered to be equivalent to the "lower Fern Glen." Sandstone and sandy shale between these formations were identified as Northview sandstone.

A composite section (after Weller, 1941, pp. 72, 73) based on outcrops on both sides of Mississippi River near Hannibal, Missouri, shows the following beds to occur in sequence below the widespread Burlington limestone: Prospect Hill sandstone, McCraney limestone, English River sandstone, Hannibal (or Maple Mill) shale, and Louisiana limestone. Corals with close Chouteau affinities are known from the McCraney and Prospect Hill, these being the beds of the Burlington, Iowa, section from which the types of *Leptopora typa* were collected.

Near Jerseyville, Illinois, is a very thick section of Chouteau limestone underlain in order by the Maple Mill shale, Hamburg beds, and Grassy-Saverton shale of J. M. Weller. The Hamburg beds are presumed to be equivalent to the Glen Park limestone. Corals have been collected from the Chouteau limestone at a locality northwest of Jerseyville. The Sedalia limestone is possibly present here above typical Chouteau.

The Springville shale of Union County, Illinois, contains glauconitic limestone beds near the base from which corals of Chouteau affinity have been collected. It has been considered by Weller and Sutton (1940, p. 766) to be equivalent to the Hannibal shale.

The Rockford limestone of Indiana is a thin glauconitic limestone overlain by Osage siltstone and underlain by a few inches of calcareous shale. Most of the collections from the "Rockford beds" were made many years ago and the fossils are reputed to have been collected from argillaceous limestone or calcareous shale either overlying or grading down into the typical Rockford limestone. The thin shale underlying the Rockford limestone also carries corals.

The Hampton formation of Iowa consists of four members in the north central part of the outcrop area; these members are, in descending order, the Iowa Falls, Eagle City, Maynes Creek, and Chapin. In the southeastern part of the outcrop area the Hampton formation consists of the Wassonville member, underlain by the North Hill member. The Wassonville is equivalent to the Maynes Creek, and the North Hill is equivalent to the Chapin. The Iowa Falls and Eagle City are thought to be younger than the Chouteau (restricted), and the faunas are said to be derived from the Chouteau (Laudon, 1931, p. 348). The rest of the Hampton formation is thought to be equivalent to the Chouteau.

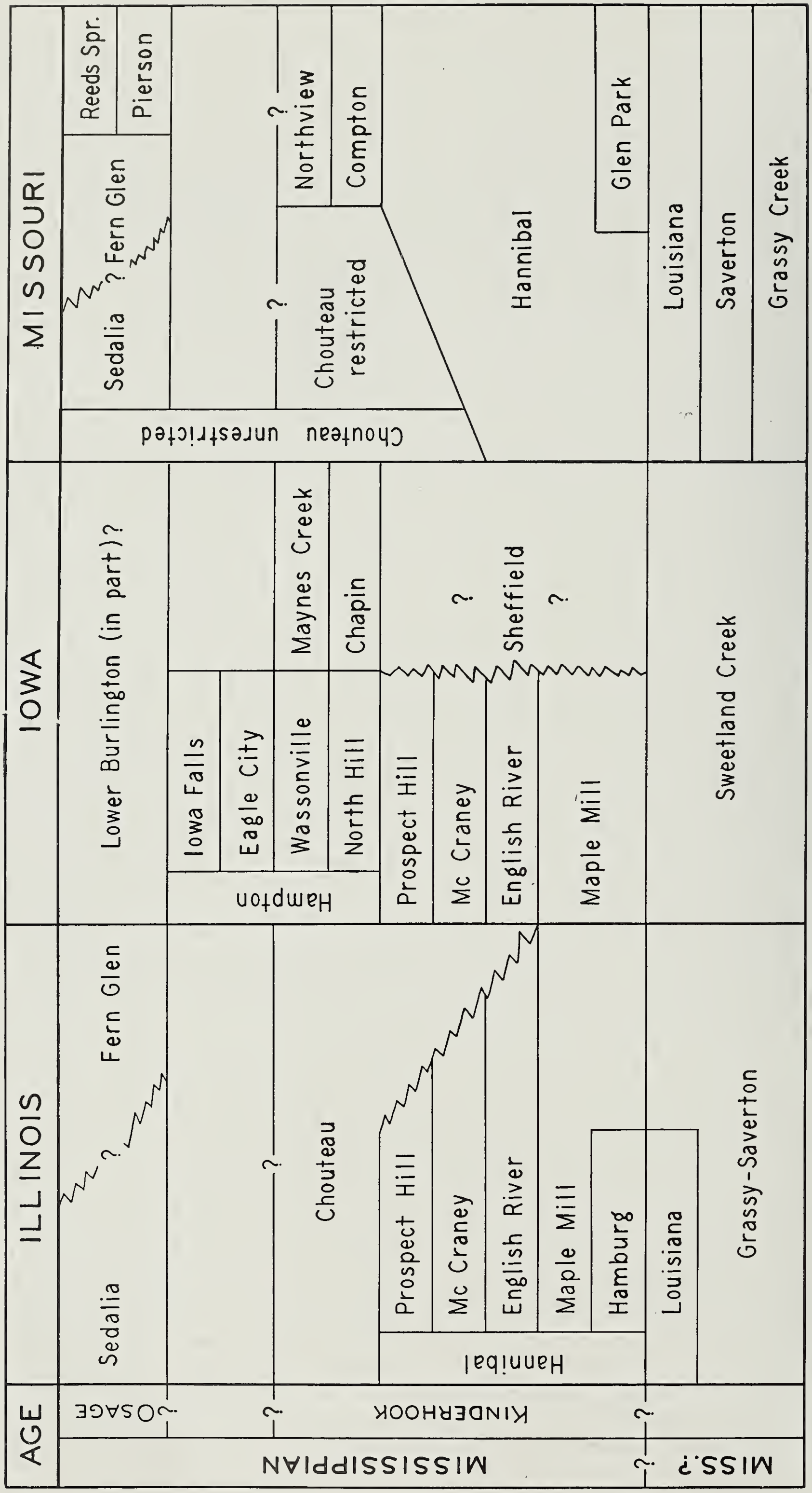

FIG. 1.—Tentative correlation of Kinderhook formations in Illinois, Iowa, and Missouri, based in part upon published conclusions of others. These correlations are not officially approved by the Illinois State Geological Survey.

The Compton limestone of southwestern Missouri contains a fauna of Chouteau affinity. It is overlain by the Northview formation which Moore (1928, pp. 126, 127) considers to be equivalent in part to the Chouteau (restricted) and to be perhaps a clastic phase of the Chouteau.

A study of the Chouteau corals leads to several conclusions:

1. The Chouteau limestone (restricted) contains essentially the same fauna throughout a large area and presumably it is everywhere of the same general age.

2. The Chouteau fauna contains elements occurring in formations as old as the Louisiana limestone and as young as the Burlington limestone.

3. Although the Sedalia and Chouteau limestones contain many species in common, they may be differentiated.

4. The "Rockford beds" of Indiana contain species known from the Chouteau; these strata are presumably equivalent to some part of the Chouteau.

5. Limestone beds at the base of the Springville shale contain corals of Chouteau and Rockford affinities; the thin limestones may therefore be equivalent to the Rockford limestone and to some part of the Chouteau limestone.

6. The Fern Glen species are almost all distinct from those in the Sedalia and Chouteau limestones; the existing tentative correlation of the Fern Glen and Sedalia is therefore questioned.

7. Among the most peculiar Carboniferous coral genera are *Palaeacis* and *Cleistopora;* because *Palaeacis* is known most abundantly from the European faunal zones K through C_2 and *Cleistopora* from Z_1 and Z_2, it seems probable that the Chouteau limestone is similar in age to some of the Z beds of British stratigraphers.

Locality List

1 Chouteau limestone (unrestricted), near Sedalia, Missouri.

2 Probably upper Chouteau limestone (unrestricted), bluffs of Missouri River, Providence, Missouri.

3 Kinderhook, in railway-cut 3 miles northeast of Morning Sun, Iowa.

4 Fern Glen formation, Illinois.

5 Shale below Rockford limestone, Rockford, Indiana (now inaccessible).

6 Lower limestone beds of Springville shale, Darty Creek, Illinois.

7 Lower part of Chouteau limestone (unrestricted), near Sedalia, Missouri.

8 Chouteau limestone (unrestricted), Pettis county, Missouri.

9 Upper part of Chouteau limestone (unrestricted), near Sedalia, Missouri.

10 Thin gray-green shale below Rockford limestone, 1.5 miles southwest of Henryville, Indiana, where road crosses Caney Fork.

11 Thin gray-green shale below Rockford limestone, 4 miles east of Underwood, Indiana, on the John Koener farm.

12 Rockford limestone (unrestricted), Rockford, Indiana.

13 Kinderhook beds, Lake Valley, New Mexico.

14 Fern Glen formation, Kimmswick, Missouri.

15 Fern Glen formation, Monroe County, Illinois.

16 *Orophocrinus conicus* zone of Hampton formation, Le Grand, Iowa.

17 Burlington limestone, Springfield, Missouri.

18 Burlington limestone, Sulphur Springs, Missouri.

19 Keokuk limestone, Springfield, Missouri.

20 Chouteau limestone (unrestricted), Knox County, Missouri.

21 Hills near Louisville, Kentucky. (Probably New Providence shale at Button Mold Knob.)

22 Chouteau limestone (unrestricted), near Warsaw, Missouri.

23 Chouteau limestone (restricted), Pancake Hollow, north of Hamburg, Calhoun County, Illinois.

24 Chouteau limestone (unrestricted), Bentonville, Missouri.

25 Chouteau limestone (unrestricted), Curryville, Missouri.

26 Oolitic limestone near base of McCraney limestone, Burlington, Iowa.

27 Prospect Hill sandstone, Burlington, Iowa.

28 Chouteau limestone (restricted), in small quarry along south branch of hollow east of Hamburg, Calhoun County, Illinois.

29 Upper Chouteau limestone, 3 miles northeast of Curryville, Missouri.

30 *Cyathaxonia arcuatus* zone of Chapin member of Hampton formation, Iowa.

31 *Productus sedaliense* zone of Maynes Creek member of Hampton formation, in abandoned quarry 1 mile west of Chapin, Iowa.

32 *Chonetes multicosta* zone of Maynes Creek member of Hampton formation, on north bank of Maynes Creek in NW. 1/4 sec. 21, Reeve Township, Iowa.

33 *Spirifer striatiformis* zone of Maynes Creek member of Hampton formation, in upper reaches of Spring Creek, northwest of Hampton, Iowa.

34 *Spirifer platynotus* zone of Iowa Falls member of Hampton formation, near Iowa Falls, Iowa.

35 *Spiriferina solidirostris* zone of Hampton formation, Le Grand, Iowa.

36 Fern Glen formation, Sulphur Springs, Missouri.

37 Kinderhook (probably Fern Glen formation), Jersey County, Illinois.

38 Chouteau limestone (restricted), Snake Den, Knox County, Missouri.

39 Near top of Chouteau limestone (unrestricted), Providence, Missouri.

40 Wassonville member of Hampton formation, Iowa.

41 *Productus sedaliense* zone of Maynes Creek member of Hampton formation, in abandoned quarry 3 miles northeast of Hampton, Iowa.

42 *Productus sedaliense* zone of Maynes Creek member of Hampton formation, on south bank of Beaver Creek, sec. 32, Washington Township, Iowa.

43 *Chonetes multicosta* zone of Maynes Creek member of Hampton formation, in abandoned quarry on south bank of Spring Creek in northern Hampton, Iowa.

44 *Pachylocrinus genista* zone of Hampton formation, near Le Grand, Iowa.

45 Louisiana limestone, Louisiana, Missouri.

46 Hannibal formation, Pleasant Hill, Illinois.

47 Hannibal formation, Rockport, Illinois.

48 Chouteau limestone (restricted), Lincoln County, Missouri.

49 Chouteau limestone (restricted), Dogtown Creek, Calhoun County, Illinois.

50 Chouteau limestone (restricted), near Sweeney, Missouri.

51 Chouteau limestone (restricted), 4 miles north of Lisbon, Missouri.

52 Chouteau limestone (restricted), on Clear Fork, southwest of Montgomery City, Missouri.

53 Probably upper Chouteau limestone (unrestricted), on Smiths Branch, south of Montgomery City, Missouri.

54 Compton limestone, in abandoned quarry on Little Sac River, 8 miles north of Springfield, Missouri.

55 Chouteau limestone (restricted), Kiesinger Bluff, on Osage River, north of Warsaw, Missouri.

56 Sedalia limestone, near Sweeney, Missouri.

57 Sedalia limestone, Kiesinger Bluff, on Osage River, north of Warsaw, Missouri.

58 Pierson limestone, along Springfield-Buffalo highway in valley of Little Sac River, Missouri.

59 Sedalia limestone, in Missouri River bluffs, near Easley, Missouri.

60 St. Joe limestone, 2 miles southeast of Reeds Spring, Missouri.

61 Sedalia limestone, Clarksville, Missouri.

62 Sedalia limestone, Hannibal, Missouri.

63 Sedalia limestone, on Noix Creek, near Bowling Green, Missouri.

64 St. Joe limestone, in Truitt quarry, south of Elk Springs, Missouri.

65 "Bed 7," Burlington, Iowa. (Prospect Hill sandstone.)

66 St. Joe limestone, 1 mile south of Noel, Missouri.

67 St. Joe limestone, 1.5 miles south of Noel, Missouri.

68 Burlington limestone, Huston quarry, Hannibal, Missouri.

69 Burlington limestone, on Noix Creek, near Bowling Green, Missouri.

70 Lower Burlington limestone, Dark Hollow, near Fulton, Missouri.

71 Burlington limestone, east of Rocheport, Missouri.

72 Lower Burlington limestone, near Sweeney, Missouri.

73 Lower Burlington limestone, west of Osceola, Missouri.

74 Burlington limestone, Springfield, Missouri.

75 Reeds Spring limestone, on Shoal Creek, east of Crane, Missouri.

76 Keokuk limestone, Lime Quarry, Pierce City, Missouri.

77 Keokuk and Upper Burlington limestones in old quarry northwest of Mt. Vernon, Missouri.

78 Chapin member of Hampton formation, in southwest corner sec. 29, Ross township, Missouri.

79 Burlington limestone, Burlington, Iowa.

80 Kinderhook limestone, on east bank of West Fork of Des Moines River, in southwest part of Humboldt, Missouri.

81 Kinderhook limestone, on south side of river near bridge, Rutland, Missouri.

82 Saverton shale, Louisiana, Missouri.

83 Louisiana limestone, Louisiana, Missouri.

84 Lower Burlington limestone, Louisiana, Missouri.

85 Chouteau limestone, Louisiana, Missouri.

86 Upper Burlington limestone, Louisiana, Missouri.

87 Upper Burlington limestone, Greene County, Missouri.

88 Ft. Payne (Keokuk) limestone, 0.5 mile north of Cruddup, Alabama.

89 Basal Ft. Payne limestone, 1 mile NW. of Calvary, Kentucky.

90 New Providence shale, Kentucky.

91 New Providence shale, Kenwood Hill, 5 miles south of Louisville, Kentucky.

92 New Providence shale, in railroad-cut 1 mile south of Petrolia, Kentucky.

93 Basal 50 feet of New Providence shale, abandoned Columbia pike, on east side of Fishing Creek, Pulaski County, Kentucky.

94 Morris Mountain shaly member of Logan formation, 8 miles east of Berea, Kentucky.

95 New Providence shale at Kings Mountain tunnel, Lincoln County, Kentucky.

96 New Providence shale in road 1¾ miles southwest of Parnell, Kentucky.

97 Grand Falls chert member of Boone formation, 10 feet below Short Creek oolite, in SE. ¼ sec. 34, T. 28, N., R. 31 W., near mouth of Jones Creek, near Joplin, Missouri.

98 St. Joe limestone, St. Joe, Arkansas.

99 Thin limestone (Boone), San Saba, Texas.

100 Boone limestone, Siloam Springs quadrangle, Oklahoma.

101 Osage limestone and chert (Upper Burlington?), sec. 25, T. 20 N., R. 19 E., Oklahoma.

102 Upper Boone limestone, Carrollton, Arkansas.

103 Upper Boone limestone, 9 miles northeast of Fayetteville, Arkansas.

104 Boone limestone, near Eureka Springs, Arkansas.

105 Chert from Boone limestone, near Sulphur Springs, Arkansas.

106 Loose chert (Boone) 0.5 mile southeast of Sulphur Springs, Arkansas.

107 New Providence shale, Whites Creek Springs, Tennessee.

108 Chouteau limestone, Annada, Missouri.

109 Chouteau limestone, east of Curryville, Missouri.

CHECK LIST SHOWING STRATIGRAPHIC DISTRIBUTION OF CORALS FROM THE CHOUTEAU AND RELATED FORMATIONS

	Burlington, Keokuk	Fern Glen	Sedalia	"Upper Chouteau"	"Lower Chouteau"	Chouteau (unrestricted)	Chouteau (restricted)	Prospect Hill	McCraney	Hannibal	Louisiana	Saverton	Rockford (unrestricted)	Springville	Compton	Pierson	Iowa Falls	Maynes Creek	Chapin	Wassonville	St. Joe	Reeds Spring	New Providence
Amplexus rockfordensis	—	—	—	—	—	—	x	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—
Aulopora ? sp.	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Caninia corniculum	x	—	—	x	—	x	x	—	—	—	—	—	—	—	—	x	—	—	—	—	x	—	—
Cladochonus striatus	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cleistopora procera	—	—	—	—	—	x	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cleistopora ramosa	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cleistopora typa	—	—	—	x	—	x	x	—	x	—	—	—	—	—	—	—	—	x	x	—	—	—	—
Cleistopora sp.	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Clinophyllum chouteauense	—	—	—	x	x	—	—	—	—	x	—	—	x	—	x	—	—	—	—	—	—	—	—
Clinophyllum excavatum	—	—	—	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Coleophyllum ? greeni	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cyathaxonia tantilla	—	x	x	x	x	—	x	—	—	x	—	—	x	x	x	—	—	—	—	—	x	—	—
Favosites divergens	—	—	—	—	—	?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Favosites ? mancus	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—
H. (Homalophyllites) calceolus	x	—	x	—	—	x	x	—	—	—	—	—	—	—	—	—	—	x	x	—	—	x	—
H. (Homalophyllites) pinnatus	—	—	—	x	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Koninckophyllum glabrum	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lithostrotion microstylum	—	—	—	x	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Meniscophyllum minutum	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Metriophyllum deminutivum	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Microcyathus enormis	—	—	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	x	—	—	—	—	—
Microcyclus blairi	x	—	x	x	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Neozaphrentis tenella	—	—	x	x	—	—	x	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—
Palaeacis conica	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pleurodictyum expansum	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pseudocryptophyllum cavum	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rotiphyllum calyculum	—	—	—	x	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rotiphyllum hians	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Syringopora harveyi	x	—	x	x	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Triplophyllites centralis	x	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x
Triplophyllites cliffordanus	x	x	—	x	—	—	x	—	—	—	—	—	—	—	—	—	x	x	x	x	x	—	—
Triplophyllites exiguus	—	x	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—
Triplophyllites ida	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—
Vesiculophyllum sedaliense	—	—	x	x	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Genus and species unidentified	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TERMINOLOGY

Terms describing Paleozoic corals in more or less common English usage have not been assembled previously in any one publication. Hill's (1935) compilation of British terminology is the most authoritative list to date, but it is far from complete. The compilation presented here includes most of the terms used since about 1900. Definitions are worded as simply as possible. Words describing fleshy parts and post-Paleozoic corals are not included.

There has never been an accepted American system of morphologic terms, probably because corals have been less studied in America than in Europe; moreover, an "American terminology" is not needed. It is necessary, however, to provide American students with an adequate index of available terms. Partial lists published by Americans include those by Robinson (1917), Grabau (1922, in a Chinese journal), Sanford (1939), Twenhofel and Shrock (1937), Moore (1933), Grabau and Shimer (1909), Grove (1934), and Moore and Jeffords (1941), but some of these compilations are only incidental and none was intended to be complete. The following list likewise is known to be incomplete, but it does contain all terms in more or less current usage. For those who wish more detailed morphologic discussions, the reader is referred to Hill (1935), Grabau (1922), and Sanford (1939).

Most of the terms included in the following list are morphologic, but a few refer to ontogenetic and evolutionary stages. Some have had more than one meaning and some are used as adjectives to modify different nouns. Synonyms are italicized after the definitions and homonyms are listed separately and numbered. Previously published definitions have been drawn upon freely without acknowledgment.

Each student has his own preference in terminology within reasonable limits. In the following glossary, some obsolete terms are indicated and others which the writer does not recommend are indicated by asterisks (*).

GLOSSARY

Acanthine septa: Discontinuous septa consisting of unfused trabeculae.

Acceleration: Addition of more secondary septa in one pair of quadrants than in the other.

Acrocolumella: Axial structure consisting of distally elevated tabulae.

Alar: Indicates lateral position or at alar septa; is determined primarily by abutting of counter septa against an alar sextum. Abbreviated: A.

Alar pseudofossula: Gap between alar septum and next adjacent counter septum. *Lateral fossula.*

Amplexoid: Having septa withdrawn toward periphery.

Amplexoid septum: Retreats from axis, lies upon upper surfaces of tabulae, and extends progressively shorter distances axially as distance from tabulae increases. *Short septum* in part.

Anastomosing: Joining, as in reticulate colonies of *Cladopora. Inosculation.*

Angulo-concentric dissepiments: Similar to concentric dissepiments except in being angular with apex directed peripherally.

Annulation*: Encircling depression on epitheca.

Apex*: Pointed end of coral. *Apical end.*

Aphroid: Plocoid coralla separated by dissepiments only.

Apical end: Pointed end of coral. *Apex.*

Asexual increase: Growth or spread of coral or colony by sending out offsets. See *Budding, Gemmation, Fission.*

Astraeform: Having polygonal corallites in transverse section.

Astraeoid: Closely packed plocoid corals with indefinite boundaries between corallites.

Atavo-tissue: Tissue common to parent and offset corallites.

Attenuated septum: Thin throughout length.

Aulophylloid*: Tendency toward complex axial structures.

Aulos*: 1 Any axial structure.

Aulos*: 2 See Inner wall.

Axial area: That portion of thecarium located axially from inner wall.

Axial boss: Elevation in calyx corresponding to an axial structure. *Calicular boss.*

Axial complex: A columella or pseudocolumella; unrestricted in usage, but inferring pseudocolumella.

Axial edge: Edge of septa nearest axis.

* Term not recommended.

Axial increase: Growth by addition of two or more corallites from a calyx and having new septa and epitheca axially but continuing peripheral septa and epitheca of parent. Compound *calcular budding.*

Axial pit: Depression of floor of calyx at position of tabularium. *Calicular pit.*

Axial plate: Bisects axial column in cardinal-counter plane, may be continuous with cardinal septum or counter septum or neither. *Medial plate.*

Axial septum: Jointed counter and cardinal septa.

Axial series: Tabulae near axis of corallite. *Axial zone.*

Axial tabula: One of inner series.

Axial vortex: Axial structure formed by twisting of axial ends of septa. *Streptocolumella.*

Axial zone*: Tabulae near axis of corallite. *Axial series.*

Basal budding*: Budding from margin or from definite points near base. *Marginal budding.*

Basal disk: Earliest portion of skeleton formed. *Basal plate.*

Basal epitheca*: Common investing sheath in massive coralla. *Holotheca.*

Basal plate: First formed part of exoskeleton.

Base*: Attached edge of septum. *Peripheral edge.*

Bourrelet: Encircling expansion on wall, coarser than growth-lines. *Varices.*

Bradygenesis: Retardation of ontogenetic development.

Brephic stage: Ontogenetic stage in which the six protosepta are formed. *Nepionic stage.*

Breviseptal phase: Phase characterized by short septa. *Amplexoid* in part.

Budding*: Asexual increase. *Gemmation.* See Basal, Coenenchymal, Fission, Interstitial, Marginal, Septal, Stolon, Tabular budding.

Calceolid: Conical corals flattened on one side, may have operculum.

Calice: Open end of coral; may be deep, shallow, gently concave, inverted, steep-walled. *Calyx.*

Calicinal gemmation: Budding from within the calyx.

Calicular pit: Depression of floor of calyx at position of tabularium. *Axial pit.*

Calicular platform: Area between axial pit and periphery. *Peripheral platform.*

Caliculum*: Simple cup-shaped individual.

Calyx: Open end of coral; may be deep, shallow, gently concave, inverted, steep-walled. *Calice.*

Calyx walls: Lateral portion of calyx, generally consisting of inner edges of septa.

Caninoid: Corals which change from discoid through trochoid to cylindrical.

Cardinal: Indicates position of structures or areas within thecarium; cardinal septum determined primarily by location of herringbone pattern of septa on theca; cardinal quadrants lie between alar septa and cardinal septum. Abbreviated: C.

Cardinal pseudofossula*: Gap between cardinal septum and next adjacent septum.

Carina: Vertical or horizontal flange on septa; may be reduced to rows of spines.

Carinate: Having carinae.

Ceratoid: Conical corals with apical angle of about 20°.

Cerioid: Massive corals possessing individual walls.

Coenenchymal budding: Development of new corallite from connective tissue in massive coralla.

Coenenchyme: Common connective tissue between corallites of some massive coralla.

Columella: Simple solid axial rod or plate extending lengthwise. *Columnella.*

Columnella*: See Columella.

Complete tabulae: Extend across thecarium.

Concentric dissepiments: Have uniformly arched upper surfaces convex distally, uniformly distributed between septa.

Cone-in-cone: Superimposed series of proximally tilted tabulae.

Conical: Cone-shaped. See Calceolid, Ceratoid, Haploid, Patellate, Pyramidal, Trochoid, Turbinate.

Conico-cylindrical: Conical proximally and cylindrical distally.

Contiguous: Touching.

Continuous septum: Septum with trabeculae 1 completely fused to form longitudinal plate.

Contratingent: Minor septa joined to adjacent major septa towards counter quadrants.

Corallite: 1 Skeleton of simple coral.

Corallite: 2 Skeleton of individual coral in a colony.

Corallum: 1 Skeleton of a compound coral.

Corallum: 2 Skeleton of a simple coral.

Costa: 1 Longitudinal ridge on epitheca coinciding in position with a septum.

* Term not recommended.

Costa*: 2 (Obsolete.) Longitudinal ridge on epitheca located between septa. *Interseptal ridge.*

Costal budding: Increase from thecal region.

Counter: Indicates position of structures or areas within thecarium; determined primarily by parallel bordering septa; cardinal quadrants lie between alar septa and counter septum. Abbreviated: K or CT.

Counter-laterals: First pair of secondary septa; may be grouped with primary septa. Abbreviated: CL.

Crenulate: Zig-zag or serrated epitheca of corallites in compound coralla.

Crossbar carinae: Crossbars at position of septa in peripheral region if the septa are absent.

Curved: Used to modify designation of shape in simple corals, typically cardinal quadrants are on concave side, counter quadrants on convex side.

Cyathophylloid: Tendency toward radial symmetry.

Cyathotheca: Inner wall formed by fusion of down-turned margins of tabulae.

Cylindrical: Uniform in diameter, especially in mature portions.

Cyst*: See Dissepiment or Cystosepiment.

Cystiphylloid: Tendency toward abundant dissepiments.

Cystocolumella: Axial structure consisting of cysts.

Cystosepiments: Large dissepiment-like structures differing from dissepiments by arising independently of septa; not sharply differentiated from dissepiments.

Dendroid: Fasciculate with branching corallites.

Denticulate: Serrate axial edges of septa. *Acanthine* in part.

Diaphragm: 1 Transverse partition in tubular area of *Cleistopora* and *Cladopora.*

Diaphragm*: 2 (Obsolete.) See Tabula.

Dichotomous: Branching by pairs, as in ramose Favositidae.

Dilated septum: Thick throughout length.

Diphymorph: Corallite expressing new orthogentic trend within compound corallum.

Directive septa*: Cardinal, counter, and alar septa. *Primary septa.*

Discoid: Button or coin-shaped.

Discontinuous septa: Septum with trabeculae not completely fused to form longitudinal plate. See Acanthine, Amplexoid, Lonsdaleoid, Naic, Perforate septa, Retiform, Septal cone, Septal fillets, Septal grating.

Dissepiment: Small distally arched structure, convex upward, occurring next to theca but between septa, except where septa do not reach theca (lonsdaleoid septa).

Dissepimentarium: Peripheral zone of dissepiments.

Distal: Youngest portion.

Endotheca*: 1 Portion of corallite encircled by theca. *Thecarium.*

Endotheca: 2 All structures within theca except columella and septa.

Ephebic stage: Ontogenetic stage possessing specific characters (adult).

Epitheca: External sheath of corallites; commonly indicates development subsequent to formation of primary coral wall. *Outer wall.*

Epithecal projection: Horizontal tube connecting adjacent corallites in fasiculate colonies. *Fistula.*

Everted: Periphery of calyx lower than floor.

Exotheca: All structures outside of (but including) theca.

Exothecal scales: Small plates attached in vertical rows to septal grooves. *Scales.*

Extra-calicinal budding: Increases other than from calyx.

False costa*: (Obsolete.) Longitudinal ridge on epitheca between septa. Interseptal ridge. *Costa* 2.

Fasciculate: Corallites of compound corals not touching. See Dendroid, Phaceloid.

Fiber*: (Obsolete.) See Trabecula 1.

Fission: Separation of calyx by cleavage.

Fission budding: Extension of features of parent corallite into new corallite (polyp may be separated from parent polyp by closing off of area of juncture).

Fistula: Connecting tube between neighboring corallites of fosciculate coralla. *Epithecal projection.*

Fossula: 1 Gap formed by abortion of a septum.

Fossula: 2 Gap formed by shortening of a septum, also by down-warping of tabulae at same position. *Siphonofossula* in part.

Fovea*: (Obsolete.) See Fossula.

Gemmation: Asexual increase. *Budding.*

Geniculate: Having abrupt change in direction of growth. *Scolecoid* in part.

Genomorphic group: Diphymorphs of coralla or entire genus.

Gerontic stage: Ontogenetic stage characteristic of old age.

Granulose: Having very small granules on epitheca or tabulae.

* Term not recommended.

Growth line: Fine encircling irregularity on theca.

Haploid: Simple conical coral.

Holotheca: Outer wall or common investing sheath in massive coralla. *Peritheca.*

Horizontal skeletal element: Structure formed at base of living coral.

Horizontal bar*: See Tabula, especially in Favositidae.

Horseshoe dissepiment: Domed dissepiment resting on flat horizontal base near inner edge of dissepimentarium.

Hystero-brephic: Very early stage with possible omission of characters in offset corallite.

Hystero-corallite: Skeleton of offset corallite formed after the proto-corallite.

Hystero-ephebic: Adult stage with possible omission of characters, in offset corallite.

Hystero-neanic: Early stage with possible omission of characters, in offset corallite.

Incomplete tabula: Not extending across thecarium.

Increase: Asexual growth. *Budding, Gemmation.*

Infundibuliform: Cone- or funnel-shaped.

Inner wall: Solid longitudinal structure simulating internal theca. See Phyllotheca, Sclerotheca, Cyathotheca, Stereotheca.

Inosculation*: Joining. *Anastamosing.*

Interior wall*: (Obsolete.) See Inner wall.

Intermural increase: Lateral increase occurring in cerioid coralla at angles between walls.

Intermural pore: Perforation of only one of two neighboring corallite walls in massive coralla.

Interrupted septum*: Not reaching theca. *Lonsdaleoid septum.*

Interseptal ridge: Vertical ridge on exterior of epitheca between adjacent septa. *Pseudoseptum* in part, *Pseudocosta, Ruga, Costa* 2.

Interseptal space: Portion of lumen between two adjacent septa.

Interstitial budding: Insertion of new corallites in interstices between corallites.

Invaginated: Tabular arching in reverse of usual manner.

Lamella: 1 Short axially located plate resembling septum.

Lamella*: 2 (Obsolete.) See Septum.

Lateral budding*: Budding from some point in walls. *Parietal budding.*

Lateral fossula*: Gap between an alar septum and next adjacent counter septum (obsolete). *Alar pseudo-fossula.*

Lateral increase: Apparent growth of new corallite from epitheca of parent.

Left counter quadrant: Position of thecarium between counter septum and left alar septum when counter is orientated away from observer.

Long septum: Extending almost to axis.

Lonsdaleoid: Having septa withdrawn from periphery, outer space filled by dissepiments. *Recessive* septa in part.

Lonsdaleoid dissepiments: Abut against either epitheca or other dissepiments because of retreat of septa toward axis.

Lonsdaleoid septum: Not extending to periphery. *Recessive* septum.

Lumen: Space within thecarium not occupied by skeletal elements.

Major septa: Protosepta and metasepta.

Marginal budding*: Budding from margin or from definite points near base. *Basal budding.*

Massive: Compound corals with actually touching corallites. See Cerioid, Plocoid, Prismatic.

Medial lamella: Axial plate generally in cardinal-counter plane.

Medial plate*: Bisects axial column in cardinal-counter plane, may be continuous with cardinal septum or counter septum, or neither. *Axial plate.*

Metasepta: Long septa resembling protosepta but in intermediate position. *Secondary septa.*

Minor septa: Short septa inserted subsequent to and alternating with major septa. *Tertiary septa,* in part.

Mural pore: Perforation extending through epithecas of two adjacent corallites, as in Favositidae.

Naic septum: Formed in part by transverse plates connected by rods or granules of sclerenchyme.

Neanic stage: Ontogenetic stage between brephic and ephebic stages.

Neotissue: New tissue, commonly thicker than atavo-tissue.

Nepionic stage: Ontogenetic stage in which the six protosepta are formed. *Brephic stage.*

Offset: Corallite formed later than and from proto-corallite.

Operculum: Lid covering calyx.

Outer wall: External sheath of corallite. *Epitheca.*

Outer zone*: See Dissepimentarium.

Pali*: Short vertical plates located axially. Lamella 1.

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* Term not recommended.

Palicolumella: Axial structure consisting of thickened or unthickened axial plate partially separated from counter septum.

Palmate: Septa in bunches with one septum near the middle being generally the longest.

Parietal budding: Budding from some point in walls. *Lateral budding.*

Parricidal budding. Involving death of parent polyp.

Patellate: Conical corals with apical angle of 120° or more.

Perforate septum: Discontinuous septum with trabeculae forming open meshwork.

Perforate septum: Having holes.

Periaxial tabula*: 1 One of outer series.

Periaxial tabula: 2 Tabula between axial series and inner wall.

Peripheral area: That portion of thecarium located peripherally from inner wall.

Peripheral edge: Attached edge of septum. *Base.*

Peripheral increase: Formation of offsets consisting mainly of neo-tissue, originating from dissepimentarium.

Peripheral platform: Area between axial pit and periphery. *Calicular platform.*

Peritheca: 1 Outer wall of compound coral. *Holotheca.*

Peritheca*: 2 Sheath covering proximal portions of colony.

Petraeoid: Addition of stereoplasm in space left by amplexoid retreat of septa.

Phase: Part of coral differing from remainder without ontogenetic cause.

Phyllotheca: Inner wall formed by bending of septa at right angles and fusion of bent portions.

Phaceloid: Fasciculate with parallel corallites.

Pinnate: Tendency of some septa (notably in cardinal quadrants) to lean toward cardinal septum.

Platform: Flat bottom or floor of calyx.

Plocoid: Massive corals without individual walls between corallites.

Polyp*: 1 Living coral.

Polyp: 2 Fleshy part of a coral.

Polypidum*: (Obsolete.) Colony, especially of prostrate corals. *Corallum.*

Primary septa: 1 Cardinal, counter, and both alar septa.

Primary septa*: 2 Cardinal, counter, both alar, and both counter-lateral septa. *Protosepta.*

Principal septa: Primary 2 and secondary septa.

Prismatic: Massive corals with adjacent corallites in contact at all points. *Astraeform,* in part.

Proliferation*: Increase of corallum. *Budding, Gemmation* in part.

Prostrate: Lying horizontally or close to substance upon which calyx grows.

Protocorallite: Skeleton of initial corallite in colony.

Protosepta: Cardinal, counter, both alar, and both counter-lateral septa. *Primary septa* 2.

Prototheca: Conical or cup-shaped embryonic exoskeleton.

Proximal: Oldest portion.

Pseudocolumella: Axial structure more complex than columella.

Pseudocosta: Longitudinal ridge on epitheca not coinciding with septa. *Intersepted ridge, Ruga, Costa* 2.

Pseudoseptum: Vertical ridge on exterior of theca; unrestricted in usage. *Interseptal ridge,* in part.

Pseudothecalia: False theca formed by thickening, fusion of peripheral ends of septa.

Pyramidal: Conical corals flattened on three or four sides.

Quadrant: One fourth of thecarium; either cardinal or counter indicating position between an alar and either cardinal septum or counter septum.

Radial: Radiating from axis, especially relating to septal pattern in late stages.

Radiciform process*: Prolongation near the apex. *Rootlet.*

Recessive: Septa not reaching periphery. *Lonsdaleoid septa.*

Rejuvenation: 1 Addition of new constricted calyx smaller than parent but otherwise identical. *Rejuvenescence* in part.

Rejuvenation: 2 Addition of new calyx within parent calyx; unrestricted usage.

Rejuvenescence: Constriction of corallite followed by expansion, involving recapitulation of youthful characters. *Rejuvenation* 1 in part.

Reticulate: Forming mesh-work.

Retiform septum: Perforate with connecting bars between it and adjacent septa.

Rhopaloid septum: Axially swollen or dilated.

Right cardinal quadrant: Portion of thecarium between cardinal septum and right alar septum when counter is orientated away from observer.

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* Term not recommended.

Right counter quadrant: Portion of thecarium between counter septum and right alar system when counter is orientated away from observer.

Rootlet: Root-like prolongation near apex. *Radiciform process.*

Root-like process*: Proximally directed prop generally confined to proximal portion.

Ruga*: 1 (Obsolete.) Longitudinal ridge on epitheca not coinciding with septa. *Pseudocosta, Interseptal ridge, Costa* 2.

Ruga: 2 Encircling striation on epitheca coarser than transverse striation.

Rugose: Corals with metasepta inserted at four points.

Scales: Small plates attached in vertical rows to septal grooves and interseptal ridges. *Exothecal scales.*

Sclerenchyme: Calcareous material of skeleton. *Stereoplasm, Stereome.*

Sclerocolumella: Axial structure consisting of irregularly deposited calcareous material in late stages.

Sclerotheca: Inner wall formed by densely packed ring of dissepiments.

Scolecoid: Cylindrical corals whose direction of growth is irregular. *Geniculate* in part.

Secondary septa: Principal septa added later than primary septa but before any possible tertiary septa. *Metasepta,* in part.

Secondary wall*: (Obsolete.) See Inner wall.

Septal budding: Partitioning of parent calyx into two to four subdivisions by curving of primary septa.

Septal cone: Hollow cones with apex (either central or eccentric) directed proximally, cone thinning distally.

Septal fillet: Discontinuous septum with trabeculae fused to form band-like septa in horizontal bands.

Septal grating: Discontinuous septa with superimposed comb-like unfused trabeculae.

Septal groove: Longitudinal depression corresponding in position to septum. *Septal sulcus.*

Septal ridge: Very short vertical ridge on inside of epitheca at position of septum.

Septal sulcus*: Longitudinal groove on theca, corresponding to position of septum. *Septal groove.*

Septum: Longitudinal plate extending inwards from epitheca; may be acanthine, carinate, thin, dilated, long, short, amplexoid, sinuous, retiform, perforate, continuous, discontinuous.

Shape stage: Portion of coral characterized by recognizable difference in external form.

Short septum: Extending only short distance axially from periphery. *Amplexoid septum* in part.

Simple: Corals which lived singly, as opposed to compound corals. *Solitary.*

Siphonofossula: Deep fossula with downwarped tabulae.

Smooth: Character of theca.

Solitary: Corals which lived singly, as opposed to compound corals. *Simple.*

Spine: Outwardly directed extension on theca.

Spinulose striation*: See Septal ridge.

Squamula: Degenerate tabula terminating in free edge within lumen; may overlap other squamulae (interlocking).

Stereocolumella: Axial structure consisting of stereoplasm deposited in late stages.

Stereome: Calcareous secondary deposit upon skeletal structures. *Sclerenchyme, Stereoplasm.*

Stereoplasm: Calcareous secondary deposit upon skeletal structures. *Sclerenchyme, Stereome.*

Stereotheca: Inner wall formed by addition of stereoplasm to skeletal parts in ring within thecarium.

Stereozone: Portion of corallite extensively built up by stereoplasm.

Stolon budding: Origination of new bud from horizontal tube connecting neighboring corallites; all three units have connected visceral cavities.

Stolonal budding: Increase by sending out creeping basal prolongations from which new corallites arise.

Straight: Used to modify designation of shape in simple corals.

Streptocolumella: Axial structure caused by twisting of ends of septa. *Axial vortex.*

Synapticula: Transverse conical or cylindrical bar between septa.

Tabella: Short arched tabula located axially, generally associated with lamellae.

Tabula: Transverse skeletal elements forming floor of calyx at each successive stage; commonly best developed in central region; may be complete or incomplete.

Tabular budding: Origination of new calyx from wall of parent but enveloped by tabula.

Tabularium: Axial zone of tabulae.

Tachygenesis: Acceleration of ontogenetic development.

Talon: Arched lateral expansion near apex.

* Term not recommended.

Tertiary septa: Late-formed generally short septa inserted between neighboring principal septa. *Minor septa,* in part.

Thamnastraeoid: Closely packed phaceloid corals without boundaries between corallites and with septa of adjacent corallites confluent.

Theca: External sheath of corallites; commonly of unrestricted significance.

Thecarium: Portion of corallite encircled by theca. *Endotheca.*

Trabeculae: 1 Microscopic longitudinal spicular elements forming septa.

Trabeculae*: 2 Irregularly formed skeletal tissue characteristic of *Cleistopora* appearing reticulate in section.

Transverse striation: Fine encircling striations on epitheca.

Trochoid: Conical corals with apical angle of about 40°.

Varice: Encircling irregularity on wall coarser than growth-line; may be expansion or constriction. *Bourrelet* in part.

Vertical skeletal element. Structure formed by invagination of polyp in more or less vertical plane.

Vesicular*: Having dissepiments.

Wall*: Outer sheath. *Theca, Epitheca, Outer wall.*

Yard-arm carinae: Carinae opposed in position on the two sides of a septum.

Zaphrentoid stage: With axially coalesced pinnate septa, very large cardinal fossula, complete tabulae; possibly common to all rugose corals.

Zooid*: Individual coral within compound corallum. *Corallite.*

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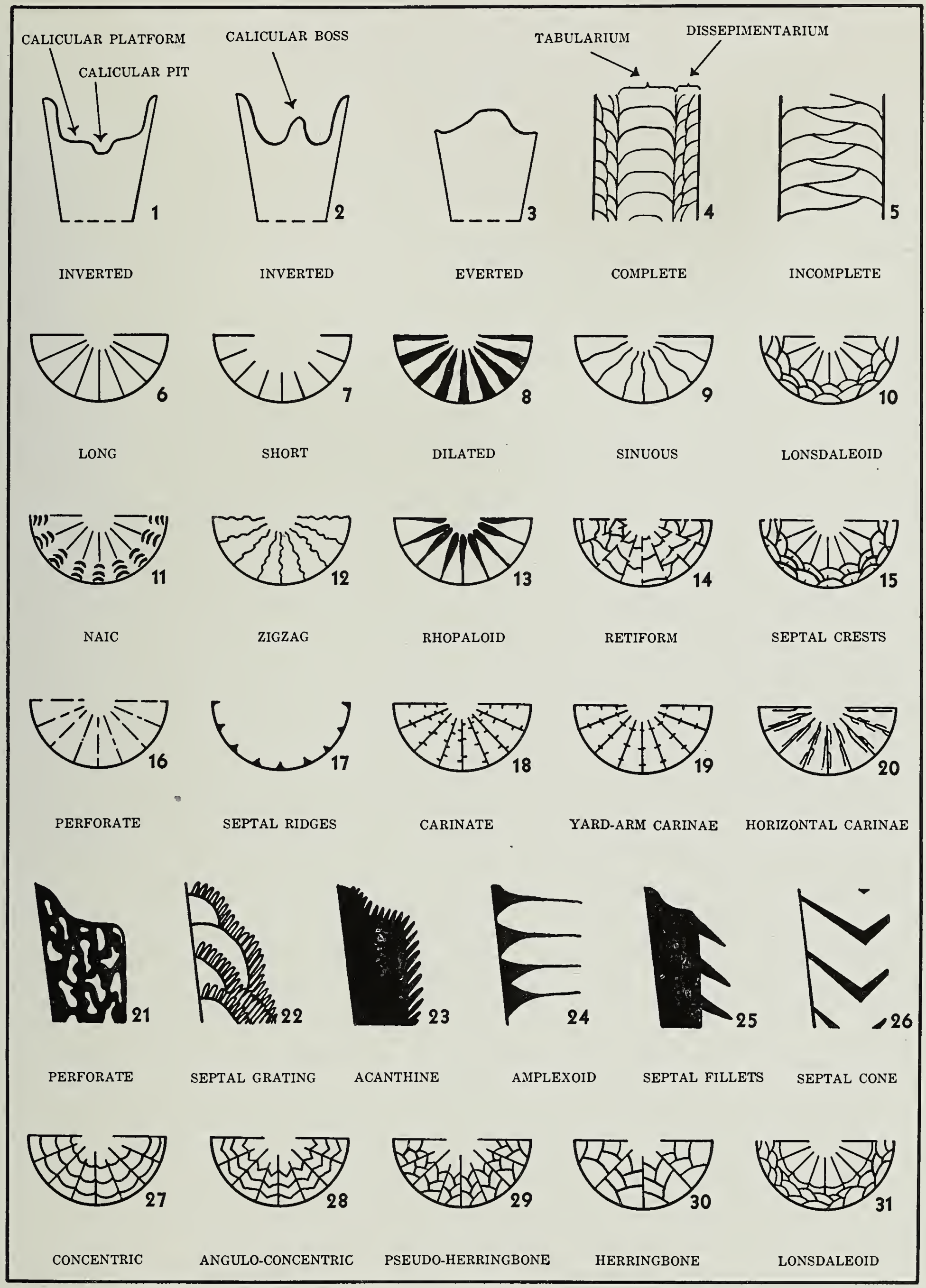
* Term not recommended.

EXPLANATION OF PLATE 1

Figs.	1-3	Longitudinal sections of distal portions of corallites.
	4, 5	Longitudinal sections showing types of tabulae.
	6-20	Transverse sections showing types of septa.
	21-26	Longitudinal sections of left half of corallites showing types of septa
	27-31	Transverse sections showing types of dissepiments.


CALICULAR PLATFORM
CALICULAR PIT
CALICULAR BOSS
TABULARIUM
DISSEPIMENTARIUM
1
2
3
4
5
INVERTED
INVERTED
EVERTED
COMPLETE
INCOMPLETE
6
7
8
9
10
LONG
SHORT
DILATED
SINUOUS
LONSDALEOID
11
12
13
14
15
NAIC
ZIGZAG
RHOPALOID
RETIFORM
SEPTAL CRESTS
16
17
18
19
20
PERFORATE
SEPTAL RIDGES
CARINATE
YARD-ARM CARINAE
HORIZONTAL CARINAE
21
22
23
24
25
26
PERFORATE
SEPTAL GRATING
ACANTHINE
AMPLEXOID
SEPTAL FILLETS
SEPTAL CONE
27
28
29
30
31
CONCENTRIC
ANGULO-CONCENTRIC
PSEUDO-HERRINGBONE
HERRINGBONE
LONSDALEOID

EXPLANATION OF PLATE 2

Fig. 1-5 Transverse sections showing types of inner walls; fig. 4 is a dissepimental stereotheca; fig. 5 is a septal stereotheca.

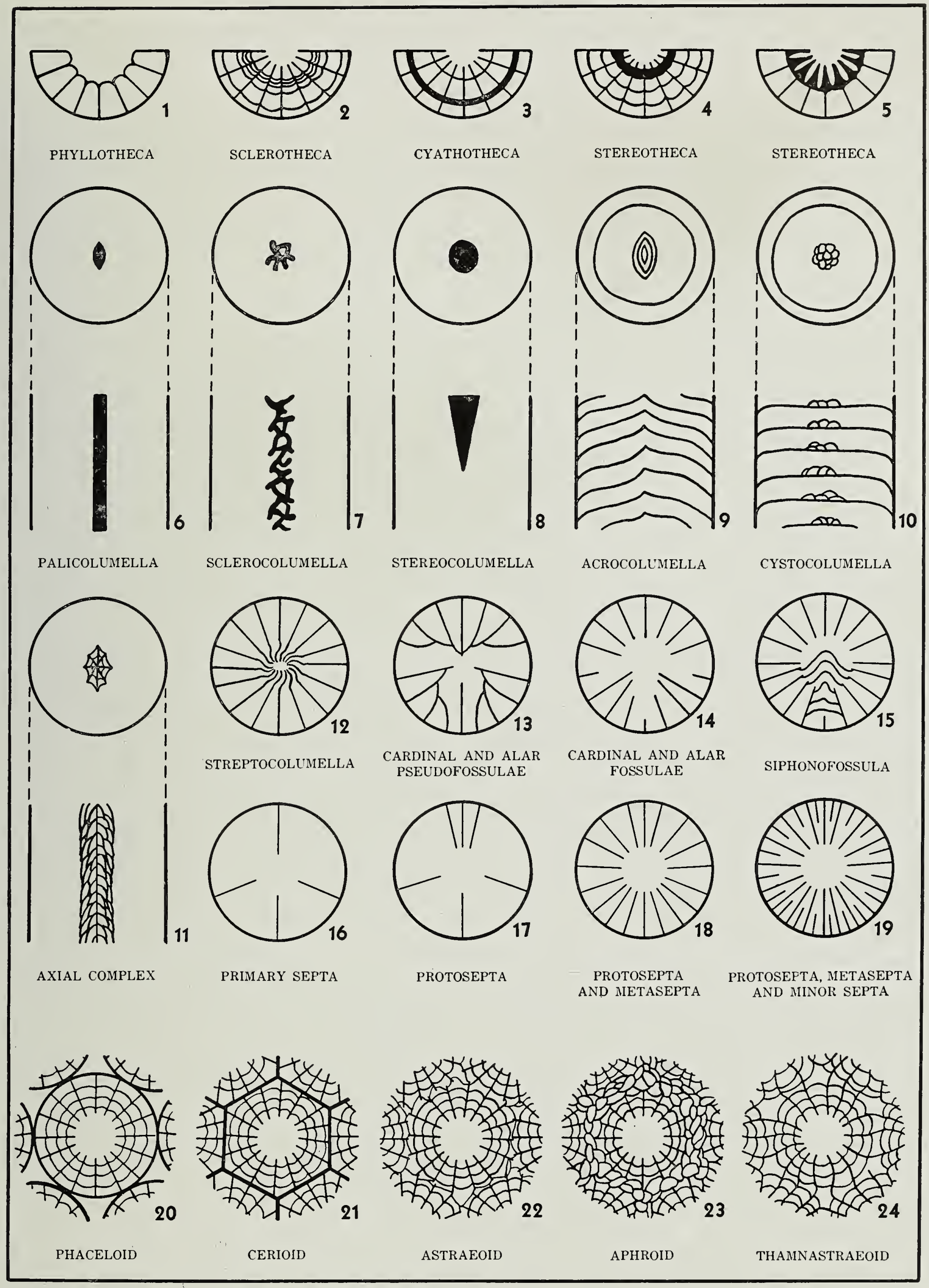
6-12 Transverse (above) and longitudinal (below) sections showing types of axial columns.

13-15 Transverse sections showing types of fossulae.

16-19 Transverse sections showing appearances of various septal groups.

20 Transverse section of one corallite and portions of surrounding corallites in a phaceloid corallum.

21-24 Transverse sections of one corallite and portions of surrounding corallites in plocoid coralla.


1
PHYLLOTHECA
2
SCLEROTHECA
3
CYATHOTHECA
4
STEREOTHECA
5
STEREOTHECA
6
PALICOLUMELLA
7
SCLEROCOLUMELLA
8
STEREOCOLUMELLA
9
ACROCOLUMELLA
10
CYSTOCOLUMELLA
11
AXIAL COMPLEX
12
STREPTOCOLUMELLA
13
CARDINAL AND ALAR PSEUDOFOSSULAE
14
CARDINAL AND ALAR FOSSULAE
15
SIPHONOFOSSULA
16
PRIMARY SEPTA
17
PROTOSEPTA
18
PROTOSEPTA AND METASEPTA
19
PROTOSEPTA, METASEPTA AND MINOR SEPTA
20
PHACELOID
21
CERIOID
22
ASTRAEOID
23
APHROID
24
THAMNASTRAEOID

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SYSTEMATICS

PHYLUM COELENTERATA
CLASS ANTHOZOA
ORDER TETRACORALLA

Family Paleocyclidae Dybowski, 1873

Genus Microcyclus Meek and Worthen, 1868

Thin, discoidal, almost flat free corolla with a small central irregular basal scar of attachment and a shallow calyx provided with smooth septa arranged in four groups separated by fossulae of which the cardinal one, with a conspicuous cardinal septum, is best developed. Major septa merging into a smooth central area; minor septa short and often attached to the major. The smooth septa and conspicuous cardinal fossula with its cardinal septum are characteristic of *Microcyclus,* which represents the stage of development in the family at which all the fossulae but the cardinal one are inconspicuous. (Bassler, 1937, p. 193.)

Genotype. — *Microcyclus discus* Meek and Worthen.

Occurrence.—Devonian of Illinois, New York, Virginia, Germany, Canada, and Spain; Chouteau limestone, Sedalia and Providence, Missouri.

Microcyclus Blairi Miller

Plate 16, figures 9, 10

Microcyclus blairi Miller, 1891, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 7, pl. 9, figs. 27, 28. Adv. Sheets.

Microcyclus blairi, Miller, 1892, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 261, pl. 9, figs. 27, 28.

Microcyclus blairi, Miller, 1892, North American Geology and Paleontology, App. 1, p. 669, fig. 1201.

Microcyclus blairi, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 117.

Microcyclus blairi, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 97, 154, 186, 195.

Microcyclus blairi, Bassler, 1937, Jour. Paleontology, vol. 11, p. 196, pl. 31, fig. 17.

Description.—In young specimen (diameter 7.5 mm) with 22 septa, 4 cardinal major septa lie on either side of short cardinal septum; counter septum extends onto central depressed smooth area; lateral spines occur on some septa in right counter quadrant.

Mature specimen (holotype, diameter 12.3 mm) has 26 primary septa alternating with very short secondary septa, which fuse with primaries on cardinal sides of septa; central smooth area slightly convex; five primaries in each cardinal quadrant.

Longer cardinal septum in slightly later stage.

Occurrence.—Localities 1, 2, 56, ?59, ?63, 73.

Material.—Specimens studied, 8. Original figured cotypes, University of Cincinnati Nos. 3998 and 3999; other cotypes, University of Cincinnati No. 4000; additional studied specimens, University of Missouri No. 1042.

Remarks.—The writer hereby selects as holotype the cotype figured by Miller on plate 9, figure 27 (University of Cincinnati No. 3998).

Family Cyathaxonidae Milne-Edwards and Haime, 1850

Genus Cyathaxonia Michelin, 1847

Small ceratoid Rugose corals with a tall columella developed independently of, but in contact with, the major septa, and with minor septa inserted alternately with the major septa; with complete tabulae inclined down to the epitheca, and without dissepiments. Hill (1940, p. 194).

Genotype.—*Cyathaxonia cornu* Michelin, 1847.

Occurrence.—The genus is known from Z_2 in the Lower Carboniferous into the Lower Permian and has been recognized in Belgium, Ireland, England, Scotland, Russia, Australia, and the United States. In this country it is known from the Chouteau limestone (unrestricted) of Missouri, the Fern Glen formation of Illinois, the shale beneath the Rockford limestone of Indiana, and the lower limestone beds of the Springville shale in Illinois. Possible Devonian representatives are known.

Remarks.—According to Hill (1940, p. 194) *Cyathaxonia* Thomson, 1878 is not referable to *Cyathaxonia* Michelin, 1847, but *Cyathocarina* Sochkine, 1928 is a junior subjective synonym.

For details of cyathaxoniid septal insertion, see Faurot (1909, pp. 69-108), Hill (1940, p. 194), Grabau (1922, pp. 68, 69), and Grove (1934, p. 121).

Cyathaxonia arcuatus Weller is not reviewed in this study because the writer believes this species to be misidentified when listed from beds lower than the Fern Glen.

Cyathaxonia tantilla (Miller) emend. Easton

Plate 6, figures 7, 8; Plate 16, figures 16, 17

Zaphrentis tantilla Miller, 1891 [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 11, pl. I, figs. 23, 24. Adv. Sheets.

Zaphrentis tantilla, Miller, 1892 [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., pp. 621-622, pl. I, figs. 23, 24.

Zaphrentis tantilla, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 111.

Zaphrentis tantilla, Keyes and Rowley, 1897, Proc. Iowa Acad. Sci., vol. 4, p. 30.

Cyathaxonia minor Weller, 1909, Geol. Soc. America Bull., vol. 20, p. 270, pl. 10, figs. 14-17.

Cyathaxonia minor, Snider, 1914, Jour. Geol., vol. 22, no. 6, p. 17.

?Cyathaxonia minor, Girty, 1915, U. S. Geol. Survey Bull. 598, p. 29.

C[yathaxonia] minor, Snider, 1915, Oklahoma Geol. Survey Bull. 24, p. 23.

Cyathaxonia minor, Purdue and Miser, 1916, U. S. Geol. Survey Folio 202, p. 11.

Cyathaxonia minor, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 148, 163, 191, 195.

Cyathaxonia minor, Croneis, 1930, Arkansas Geol. Survey Bull. 3, pp. 47, 49.

Cyathaxonia minor, Cline, 1934, Amer. Assoc. Petrol. Geol. Bull., vol. 18, no. 9, pp. 1140, 1144.

Cyathaxonia tantilla, Grove, 1935, Am. Midland Naturalist, vol. 16, pp. 367, 368, pl. 9, figs. 15-17.

Cyathaxonia tantilla, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 53, 93, 96, 97, 120, 154, 195.

Description.—Small, curved cylindrical, commonly geniculate corallites; calyx deep, with prominent elliptical axial boss, sharp but short septa lining nearly vertical walls; epitheca moderately thick, very finely striate to rugate, obscure septal grooves when unweathered.

Transverse sections.—In late ephebic stage (diameter 2.7 mm), 24 septa—one cardinal, one counter with simple septum on either side, then 5 pairs of septa on each side uniting just short of columella; columella practically undifferentiated, one-fourth of diameter of calyx, slightly elliptical, long axis directed counter-cardinally, fused with tips of septa; septal spines very rare.

Most advanced stage observed (diameter 3.5 mm) with 28 septa lining walls of calyx.

Broken tip in early ephebic stage (diameter 1.3 mm) with 21 septa, cardinal, counter and one lateral septa all single, four pairs of septa on one side, five on other; extra pair on side of acceleration during geniculation. Small spines abundant on sides of septa.

In neanic stages precise structure obscure; at 0.9 mm about 10 or 12 septa, columella present.

In general, paired septa consist of one main septum and shorter auxiliary joining on side away from cardinal septum.

Longitudinal section.—Columella extending well into calyx; septal spines quite prominent, in arched series sloping inward and downward; dissepiments not observed; tabulae extremely thin, about 0.7 mm apart, sloping gently upward axially.

Occurrence.—Localities 2, 4-7, 46, 50, 52-54, 56, 60, ?61, 64, 75, 84, 98. This species has also been reported from the Burlington limestone at Louisiana and Hannibal, Missouri, by Keyes (1894, p. 111), but according to McQueen[1] there are no specimens listed in the Missouri Geological Survey collection to substantiate this report.

Material.—Specimens studied, 68. Holotype, University of Cincinnati No. 3940; paratypes, University of Cincinnati No. 3941, 24404; Grove's hypotypes, University of Chicago No. 38042; other studied material, United States National Museum not numbered, Illinois State Geological Survey Nos. 3509, 3516, University of Missouri not numbered, and University of Chicago No. 9855.

Remarks.—Miller designated 31 specimens as cotypes of this species. One cotype, which most closely fits the original illustrations, and which bears a different number (University of Cincinnati No. 3940) is hereby designated the holotype. This is 8.5 mm long and would be about 2.7 mm in greatest diameter if the calyx were not somewhat crushed. It has 26 septa and a prominent columella in the 1.5 mm deep calyx. The exterior is smooth near the tip but is weathered near the calyx. This specimen and several others were cleaned by the writer in order to establish the nature of the

[1] Correspondence, H. S. McQueen, August 26, 1942.

calyces. No traces of fossulae were observed. The "fossula" as described by Carruthers (1913) refers to a different septal distribution and not a depression at the cardinal position (see Carruthers, 1913, pl. III, figs. 4, 7, 9, 10).

Altogether, 22 of the original cotypes are referable to this species, one to *Syringopora harveyi,* one to *Paleacis* n. sp., one possibly to *Hapsiphyllum* n. sp., one to *Amplexus corniculum* Miller, three to *Metriophyllum* n. sp., and two are unidentifiable (one may be a pathologic specimen of *C. tantilla*).

Family Metriophyllidae Hill, 1939

Genus Metriophyllum Milne-Edwards and Haime, 1850

Metriophyllum Milne-Edwards and Haime, 1850, Paleont. Soc. London, p. lxix.

Metriophyllum Milne-Edwards and Haime, 1851, Polypes Foss. des Terr. Palaeoz., p. 317.

Lopholasma Simpson, 1900, New York State Mus. Bull. 39, vol. 8, p. 206.

Stereolasma Simpson, 1900, New York State Mus. Bull. 39, vol. 8, p. 205.

Lopholasma Grabau, 1922, Paleontologia Sinica, ser. B, vol. 2, fasc. 1, p. 42.

Lophelasma Lang, Smith, and Thomas, 1940, Index of Palaeozoic Coral Genera, p. 80.

Stereoelasma Lang, Smith, and Thomas, 1940, idem, p. 123.

Small, simple, ceratoid rugose corals; septa carinate, radially arranged, commonly fused axially to form a pseudocolumella; tabulae thin, sparse; dissepiments present.

Genotype. — *Metriophyllum bouchardi* Milne-Edwards and Haime.

Occurrence.—Hamilton (Devonian) of New York; probably late Viséan or early Moscovian of China; Lower Carboniferous of the British Isles; lower part of Chouteau limestone (unrestricted) of Missouri.

Material.—The specimens illustrated by Hall (1876, pl. 19, figs. 1-13) are mostly in the American Museum of Natural History, except for the original of figure 9, which is New York State Museum No. 3740/1. The location of Hall's specimens illustrated as figures 4, 6, 10 is unknown. Simpson's (1900) specimens are in the New York State Museum as follows: fig. 16, No. 3740/3; fig. 17, No. 3740/2; fig. 18, No. 3741/2; fig. 19, No. 3520/1; fig. 20, No. 3520/2; fig. 22, No. 3520/3.

Remarks.—Hill (1940, pp. 132, 136) indicated that *Metriophyllum* is a senior synonym of *Lopholasma,* but she does not use either name, preferring to retain species groups of *"Zaphrentis"* because the other pertinent genera have not been studied in detail. The writer feels that obvious differences between *Zaphrentis* and *Metriophyllum* warrant using the latter genus when it seems applicable, even though its details are imperfectly known.

Grabau (1922, p. 42) believed that "the Devonian form is probably derived from *Stereolasma rectum*" and that (p. 58) *Lophocarinophyllum* was probably derived from a coral of the *Metriophyllum* type. Jeffords reiterated the same view (1942, pp. 208-209). Hill (1940, p. 132) believed *Fasciculophyllum* was derived from corals of the *Metriophyllum* type which she includes in the *Zaphrentis omaliusi* group. Lang, Smith, and Thomas (1940, p. 123) state that *Stereolasma* and *Lopholasma* are junior synonyms of *Metriophyllum;* on the basis of examination of the figures the writer concurs. It has proved impossible to decide to which genera belong any of Hall's specimens referred to by Simpson. Simpson's types are thin-sections and are not known to have been cut from any of Hall's figured specimens.

Metriophyllum deminutivum Easton, n. sp.

Plate 3, figures 1-3

Zaphrentis tantilla Miller, 1891, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 11, Adv. Sheets.

Zaphrentis tantilla, Miller, 1892, [in part], Indiana Dept. Geol. Nat. Res., 17th Ann. Rept., pp. 621, 622.

Externals.—Small, slightly curved, ceratoid to cylindrical, slightly elliptical in cross-section; epitheca thin, very finely striate, unevenly constricted, commonly obscuring interseptal ridges; calyx deep, steep-walled, without calicular boss but with traces of septa on floor and walls.

Dimensions of specimens, all incomplete:

	Length	Greatest diameter
University of Cincinnati No. 24300 (holotype)	10.5 mm	4.2 mm
University of Cincinnati No. 24301 (paratype)	8.3 mm	4.4 mm
University of Cincinnati No. 24302 (paratype)	10.1 mm	5.5 mm

Tangential section.—(Pl. 3, fig. 2.) Septa slightly flexuous; carinae 6 in 3 mm, very prominent, extending about 0.1 mm from septa, with upward-directed hook at tip, overlapping carinae of septa on either side, but not exactly alternating with them, being nearly opposed on any one septum but lying in plane oblique through septum (except in early ephebic stage, where carinae alternate, slope downwards to septa).

Transverse sections.—(Pl. 3, fig. 3.) In middle ephebic stage (diameters 2.5 x 3.0 mm), septa thick, grouped somewhat in pairs, five pairs on each side between single thick cardinal septum and thin counter septum with single minors joining it on either side to form tripartite counter system; ends of septa fused in axis; epitheca thick; tabulae sparse, thin; occasional septal spine present.

Broken tip in late neanic stage (diameter 1.3 mm) with 8 septa united axially, only two paired.

Longitudinal section.—(Pl. 3, fig. 1.) Axial structure with traces of sinuous septa, especially in more mature stages; carinae slope gently downward axially; not more than three very fine dissepiments observed.

Comparison.—This species differs from *Lopholasma carbonaria* Grabau and *Metriophyllum battersbyi* Edwards and Haime in being notably smaller, having far fewer septa, and in very rarely showing dissepiments.

Occurrence.—Locality 7.

Material.—Specimens studied, 3. Holotype, University of Cincinnati No. 24300; paratypes, University of Cincinnati Nos. 24301, 24302.

Genus Rotiphyllum Hudson, 1942

Densyphyllum Thomson, 1883, Proc. Roy. Phil. Soc. Glasgow, vol. 14, p. 445.

Densiphyllum Vaughan, 1906, Quart. Jour. Geol. Soc. London, vol. 62, p. 318.

Densiphyllum, Vaughan, 1908, Quart. Jour. Geol. Soc. London, vol. 64, p. 459.

Densiphyllum, Smyth, 1915, Roy. Dublin Soc. Sci. Proc., n. s., vol. 14, p. 556.

non *Densiphyllum* Dybowski, 1873, Arch. Naturk. Liv-, Esth-u. Kurl. [1], vol. 5, lief 3, p. 335.

Rotiphyllum Hudson, 1942, Geol. Mag. vol. 79, no. 5, p. 257.

Rotiphyllum, Hudson, 1943b, Leeds Philos. Soc. Proc. (Sci. Sec.), vol. 4, pt. 2, p. 136.

Rotiphyllum, Hudson and Fox, 1943, Yorkshire Geol. Soc. Proc., vol. 25, pt. 2 (1942), p. 106.

Diagnosis.—"Zaphrentoid corals of *Fasciculophyllum omaliusi* species-group[2] with evenly spaced, radial, major septa which meet axially and form a stereocolumn. Cardinal fossula, on convex side of corallum, similar to other loculi except that they usually extend to the septal axis. Alar fossulae indistinguishable from other loculi. Tabulae conical. No dissepiments. Septal plan in early growth-stages similar to that in other species of *F. omaliusi* species-group." (Hudson, 1942, p. 257.)

Genotype. — *Densiphyllum rushianum* Vaughan, 1908, emend. Hudson, 1943.

Occurrence. — According to Hudson (1943b, p. 137), "Rotiphylloid structures are known in members of the *F. omaliusi* species-group from the lower Tournaisian to the top of the Viséan."

Remarks.—*Rotiphyllum* has not previously been identified in North America. Both the American species studied herein appear to be phylogenetically older than the described British material in that the American species have wider stereocolumellae, more prominent fossulae, pronounced bilateral symmetry, and a tendency toward pinnate septa in the cardinal quadrants.

Rotiphyllum calyculum (Miller) emend. Easton

Plate 3, figures 7-10; Plate 16, figures 32, 33

Zaphrentis calyculus Miller, 1891, Indiana Dept. Nat. Res. 17th Ann. Rept., p. 10, pl. 1, figs. 13, 14, Adv. Sheets.

Zaphrentis calyculus, Miller, 1892, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 620, pl. 1, figs. 13, 14.

Zaphrentis calycula, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, p. 97.

Externals. — Holotype curved trochoid, widely flaring at calyx; calyx deep with concave floor; epitheca thin with striae; holotype has 25 primaries alternating with short secondaries; tips of majors fused to central smooth area; first pair of majors on each side of cardinal septum fused before meeting smooth area; a short major on

[2] "The characteristic features of this group of small conical, and curved Rugose Corals are the position of the cardinal sectors on the convex side of the corallum, the palmate grouping of the septa which are radial or slightly concave to the cardinal septum, the stereocolumn of varying strength, the pseudofossula about a counter septum often long and rhopaloid, and the tendency of the minor septa to be contratingent with the counter-minors longer." (Hudson, 1943b, p. 104.)

cardinal side fused with each alar; right alar combination free; holotype 15 mm long on convex side, calyx 12 mm in diameter.

Paratype strongly curved, abruptly flaring, about 6 mm long on convex side, 8 mm in diameter at calyx; septa 24, with one short cardinal followed in counterclockwise direction by 2 fused, 1 free, 4 fused, 1 nearly free, 5 fused, 1 free (counter), 3 fused, 1 nearly free, 3 fused, and 2 free major septa; minor septa alternate with majors.

Another paratype (diameters 5.9 by 6.7 mm) has 18 septa, cardinal septum in fossula on convex side, followed on either side by groups of 4 septa (last of which is almost free alar septum); counter septum bordered by groups of 4 septa.

Transverse section.—One to three tabular intersections between septa in late ephebic stage. In late neanic stage of holotype (diameter 2.4 mm) cardinal septum is slightly longer than others, none reaches center, and most are short and paired near epitheca.

Longitudinal section. — Tabulae about normal to counter side, tilted proximally somewhat toward cardinal side, flat or concave; axial region composed of tabulae and axial ends of septa, all reinforced with sclerenchyme forming a flat-topped axial structure.

Occurrence.—Localities 1, 2.

Material.—Specimens studied, 36. Holotype, University of Cincinnati No. 3359; figured paratypes, University of Cincinnati No. 3359a; studied paratypes, University of Cincinnati No. 24307; unidentified original cotypes, University of Cincinnati No. 24308.

Remarks.—This species was differentiated from among the cotypes and is represented by Miller's figured specimen, here designated the holotype, plus 14 paratypes.

Rotiphyllum hians Easton, n. sp.

Plate 3, figures 4-6; Plate 16, figures 6-8

Zaphrentis calyculus Miller, 1891 [in part], Indiana Dept. Geol. Nat. Res., 17th Ann. Rept., p. 10. Adv. sheets.

Zaphrentis calyculus, Miller, 1892 [in part], Indiana Dept. Geol. Nat. Res., 17th Ann. Rept., p. 620.

Externals. — Small, trochoid, somewhat flattened; calyx oblique toward concave side, shallow, with prominent oval axial boss parallel with or oblique to cardinal-counter plane; epitheca thick, with rugae; calicular budding observed; holotype 14 mm long (convex side), 7 mm long (concave side), calyx 10.7 by 9.7 mm in diameter.

Calyx of holotype with 24 major septa, arranged as follows in counter-clockwise direction: cardinal septum prominently connected to axial boss, 1 short free major, 4 fused, 1 single (right alar), 3 fused, 2 fused, 2 fused, 1 single, 4 fused, 1 single (left alar), 3 fused, 1 single; minor septa restricted to right (convex) side.

Another specimen (diameters 11 by 9.7 mm), possesses 27 (possibly 28) majors arranged as follows (counterclockwise): cardinal septum not prominent, in pronounced fosulla, leaning to right of cardinal-counter plane, 3 fused, 2 fused and then fused to third, 1 free and short, 1 free and short (right alar), 11 single extending equally to axial boss, 1 free and short (left alar), 3 (possibly 4) single (1 extra possibly fused to last), 3 fused.

A third specimen (diameter about 7.7 mm) has 22 majors with minors alternating all around the somewhat deep, symmetrical calyx.

Transverse sections. — In very early ephebic stage (diameters 1.7 by 1.9 mm) holotype with solid central area joined by 1 cardinal, 1 lateral fused to next (right alar), 10 majors, 1 (left) alar, 2 majors next to cardinal, totaling 16 septa; suggestion of tabulae.

In section through bottom of another calyx (diameters 14.0 by 7.7 mm), 22 septa, cardinal single, counter joined about half-way on either side by other single majors. Tabular intersections abundant near epitheca.

Longitudinal section. — Columella very long, tapering; tabulae steeply oblique downwards to epitheca, both concave and convex, generally very thin.

Comparison.—This species differs notably from *R. calyculum* (Miller) emend. Easton in having a columellar boss in the calyx; otherwise the two are similar.

Occurrence.—Localities 7, 9.

Material.—Specimens studied, 8. Holotype, University of Cincinnati No. 24303; figured paratypes, University of Cincinnati Nos. 24304, 24305, 24306; figured ideotype, Illinois State Geological Survey No.

3502; other specimen, University of Cincinnati No. 24401 (as paratype of *Z. tenella*).

Remarks.—The types were formerly part of the cotypes of *Z. calycula* Miller.

Family Streptelasmidae Grabau, 1922

Pseudocryptophyllum Easton n. gen.

Diagnosis.—Simple, rugose corals; six primary septa in earliest stage observed, three (cardinal and alars) persistently strongest, longest; counter septum very strong in early stage, rapidly becoming weak, persisting into most advanced stage observed; minor septa, if any, confined to counter quadrants, well developed only in early stages; tabulae present, thick near center, very thin periaxially; dissepiments absent.

Genotype.—*Pseudocryptophyllum cavum* Easton n. sp.

Occurrence.—Chouteau limestone (unrestricted), Pettis County, Missouri.

Remarks.—This genus differs from *Cryptophyllum* in having six early septa, counter septum strongly developed early in ontogeny and persisting into late stages, secondary septa almost restricted to early stages. It differs similarly from *Plerophyllum* but also the orientation of *Plerophyllum* is the reverse of that in *Cryptophyllum* and *Pseudocryptophyllum*. *Plerophyllum* may prove to be synonymous with *Cryptophyllum,* but the Chouteau species must be placed in another genus on the basis of the six early septa and the strong counter septum in early stages. Both *Plerophyllum* and *Pseudocryptophyllum* have walls of epitheca fused with the extreme outer portions of septa. The tabulae of *Cryptophyllum* and *Pseudocryptophyllum* are similar in being axially depressed. *Pseudocryptophyllum* may have been derived from *Cryptophyllum* by additional reduction in the length of secondary septa and reduction in the strength (not necessarily length) of the counter septum. This is not borne out by the stratigraphic occurrence of the species, however, for the monotypic *Cryptophyllum* extends from Z_2 into D_2 of the British section—a range which includes almost the entire Lower Mississippian of America.

Pseudocryptophyllum cavum
Easton n. sp.

Plate 4, figures 8-11; Plate 16, figure 31

Externals.—Small, straight, ceratoid; epitheca thin with definite interseptal ridges and septal grooves, spines very sparse; corallite expands increasingly rapidly. Calyx not observed.

Transverse sections. — In late ephebic stage (9.3 by 8.3 mm) three very prominent dilated septa, cardinal and alars; counter short, flanked by axially somewhat swollen longer counter-lateral septa on either side; fairly well-defined traces of secondary septa irregular in counter quadrants, elsewhere secondary septa only swellings on periphery; all majors connected by strongly developed transected tabulae near axis; outer tabulae very thin.

In late neanic stage (diameters 4.3 by 3.5 mm), six prominent septa meeting at solid axial structure which is in reality a thick tabula; counter septum much the most dilated but shortest; rather well developed septal traces of secondaries in counter quadrants join transected tabula in slightly earlier stages; tabulae thin.

At very slightly more advanced (early ephebic) stage, septa extend almost to center, fail to meet at tabular intersection; counter much weakened, it and counter-laterals shortest of six septa present.

Longitudinal section. — Tabulae arch steeply upwards with slight axial sag; may be recurved upwards at peripheries; variable in thickness.

Comparison.—The six long major septa serve at present to differentiate the species.

Occurrence.—Localities 8, 38.

Material.—Specimens studied, 2. Holotype, University of Missouri not numbered; a possible representative is Illinois State Geological Survey No. 3510.

Remarks.—The orientation of the specimen was obtained from a study of the interseptal ridges and septal grooves.

Family Hapsiphyllidae Grabau, 1928, emend. Easton

Diagnosis.—Simple rugose corals whose major septa tend to surround a prominent cardinal fossula; minor septa may be pres-

ent; tabulae present; dissepiments may be present.

Type genus. — *Hapsiphyllum* Simpson, 1900, emend. Easton.

Remarks.—Many of the corals included in this family have formerly been included in the "Zaphrentidae" of authors. Grabau (1928, p. 118) proposed the family Hapsiphyllidae for what is essentially this group. He included *Hapsiphyllum, Allotropiophyllum,* and *Meniscophyllum* in the family. In addition to *Hapsiphyllum, Allotropiophyllum* may be a member, but *Meniscophyllum* is not typical, although it probably belongs here.

Schindewolf considered *Zaphrentoides* Stuckenberg to be a senior synonym of *Hapsiphyllum* Simpson, and therefore changed the family name to Zaphrentoididae (1938, p. 451). The writer does not recognize *Zaphrentoides* as having much taxonomic value because of lack of information about its genotype and, therefore, the family name Hapsiphyllidae is revived. This family includes *Hapsiphyllum, Neozaphrentis,* the new genus described hereunder, probably *Meniscophyllum,* and possibly *Clinophyllum.*

Genus Triplophyllites Easton, new genus

Zaphrentis of authors [in part].

Triplophyllum Simpson, 1900 [in part], New York State Mus. Bull. 39, vol. 8, p. 209.

Menophyllum Milne-Edwards and Haime, Girty, 1911, U. S. Geol. Survey Bull. 439, p. 28.

Triplophyllum, Grove, 1935, Am. Midland Naturalist, vol. 16, No. 3, p. 339.

Zaphrentoides (Hapsiphyllum) Schindewolf, 1938 [in part], Jahr. Preuss. Geol. Landesanst. (1937), vol. 58, p. 449.

Triplophyllum of authors [in part].

Diagnosis.—Simple, small to large, nearly straight to curved, conical; asexual increase very rare; calyx generally evenly concave; septa very short in upper part of calyx; epitheca generally thin, with rugae, striae, interseptal ridges, septal grooves; spines may be present; major septa very long in early stages; minor septa very short to rudimentary or absent; cardinal fossula very prominent, occupied by progressively shortened cardinal septum, bounded by generally axially fused neighboring cardinal septa; alar fossulae best developed in late neanic stage, tending to become obscure in later stages; tabulae prominent throughout; dissepiments generally sparse, irregular, mostly in early portions of corallite, usually between major and minor septa and never becoming lonsdaleoid; septal stereozones may be present.

Genotype. — *Triplophyllites palmatus* Easton, n. sp.

Occurrence.—Abundant in Mississippian of North America; Tournaisian and Viséan of Belgium, England, Russia, and Scotland.

Description of genotype

Triplophyllites palmatus Easton, n. sp.

Plate 8, figures 1-6

Externals.—Slightly curved, mostly trochoid but sometimes ceratoid; sparsely spinose; interseptal ridges strong, markedly striate, notably stronger on either side of the four primary septa; calyx deep; cardinal position commonly to one side of the concave side; sections show cardinal and alar fossulae present in the calyx, cardinal septum very short in a long narrow fossula, counter and alar septa slightly longer than other major septa.

Transverse sections.—Minor septa developed very late in ephebic stage and always rudimentary.

In late ephebic stage (diameters 14.3 by 15.8 mm) 34 major septa, of which cardinal septum is very short and located in very long, narrow fossula; counter septum slightly thicker than other septa; one or two groups of palmate septa occur in counter quadrants which are accelerated; minor septa present in a few loculi (pl. 8, fig. 1).

In middle ephebic stage (diameter 11.3 mm) 28 major septa; palmate arrangement of septa in counter quadrants quite marked; cardinal fossula long and somewhat axially expanded; long septum shown in it in plate 8, fig. 2 is a metaseptum and not cardinal septum, which is masked by stereoplasm to right of long septum.

Through progressively earlier ephebic stages (pl. 8, figs. 3a-3d) lengths of the palmate septa decrease in counter quadrants until they are indicated only by septal grooves; at the same time, cardinal septum becomes longer.

In very early ephebic and late neanic stages (pl. 8, figs. 4a-4c), number of septa further decreases; tabulae not observed in neanic stages.

Longitudinal section.—Tabulae complete, sharply recurved proximally near their borders in lower half of corallite, less sharply recurved near calyx; dissepiments very sparse, either in angle between a tabula and epitheca or enlarged with tabulae butting against them; about 7 tabulae in 10 mm.

Comparison.—*T. palmatus* differs from *T. spinulosus a* (Grove) in having the cardinal septum shortened by early ephebic stage; the pronounced palmate grouping of septa in the counter quadrants, the very strong counter septum, and the early reduction of the length of the cardinal septum are characteristic of the species internally. The generally trochoid shape, the very deep calyx, the strong interseptal ridges, and the sparse spines may provide external identifying characters.

Occurrence.—The specimens were collected by the writer from near the top of the Kinkaid limestone (Chester series, Mississippian system) in the gully to the west of the road north of Cedar Grove Church, in the NE. ¼ NW. ¼ sec. 31, T. 11 S., R. 2 E., Johnson County, Illinois. The collections came from bed 13 as measured by Lamar (Illinois Geol. Survey Bull. 48, p. 80, 1925).

Material.—Holotype, No. 3519; figured paratypes, Nos. 3520, 3521, 3522, 3523; unfigured paratypes No. 3524; topotypes No. 3525; all in the collections of the Illinois State Geological Survey. The specimens from which figs. 3a-3d and 4a-4c of plate 8 were drawn were completely ground away in an effort to obtain the earliest possible stages.

Remarks.—No other group of corals is as difficult taxonomically as the so-called "zaphrentids." Most identifications are questionable when made without sections, but even when sections are prepared, the simple morphology is misleading. The most recent nomenclatural advance has been the restriction of *Zaphrenthis* (*sensu stricto*) to corals with an open cardinal fossula, carinate or toothed septa, and a wide zone of dissepiments (Schindewolf, 1938, p. 452). No known Carboniferous corals are referable to *Zaphrenthis*.

Schindewolf (1938, p. 450) separated the Carboniferous "zaphrentid" corals into two subgenera under the genus *Zaphrentoides* Stuckenberg, 1895. Of these, *Zaphrentoides (Zaphrentoides)* has the cardinal fossula on the convex side of the corallite and *Zaphrentoides (Hapsiphyllum)* has the cardinal fossula on the concave side of the corallite. This taxonomic arrangement places corals both with and without dissepiments in the same subgenus, a condition which the writer considers unsatisfactory. The presence or absence of a major morphologic feature, such as a tendency for development of dissepiments, is of greater taxonomic value than the orientation of an existing feature, such as the cardinal fossula. Even so, the writer essentially agrees with Schindewolf that the dominent position of the cardinal fossula has taxonomic significance, that its significance is of subgeneric rank, and that the mere presence of alar fossulae is not of generic importance.

Instead of adopting a modification of Schindewolf's taxonomy, the writer feels it necessary to establish a new genus whose characters are referable to an incontrovertible genotype which, in turn, is based upon adequately known type material. *T. palmatus* is the best known species available to the writer; it is abundant at its type locality which is well established, the material is well preserved, and the species is entirely typical of the genus. For these reasons, this Kinkaid species is chosen as genotype, rather than one of the Chouteau species, all of which are less well known and either are rarely found or are based upon unavailable types. Several available genera may prove in one or more cases to be senior synonyms of *Triplophyllites,* in which instance it will be small trouble to make necessary nomenclatural changes. As it stands, one must either refer these species to a genus *(Zaphrenthis)* to which they are known not to belong or refer them to a genus whose characters are inadequately known. The status of several genera belonging in the latter category are reviewed below.

(1) *Zaphrentoides* Stuckenberg, 1895, was proposed to include corals as follows: "Simple corals whose corallites possess more or less regular conical shape. On the outer surface of the wall we percieve encircling swellings in faint impression. The septa are separated into two cycles. The septa of the first order extend almost to the axis and are slightly twisted there; are four: the cardinal septum, the counter septum, and alar septa [which are] weakly developed and situated in fossulae; of these [fos-

sulae], that of the cardinal septum is most strongly developed, whereas those of both alar septa are weakly represented and that of the counter septum is hardly noticeable. The septa of the second order, which alternate with those of the first [order], are weakly developed and are apparent only on the inner surface of the moderately deep calyx. The tabulae are complete and extend almost to the theca. An endothecal tissue is lacking or is merely present in embryonic development, wherein it is present most often in the basal part of the corallites. The genus differs from the genus *Zaphrentis* by the weak development of both alar septa of the first order and of the counter septum, which are situated in fossulae. Among the species already known, *Zaphrentoides (Zaphrentis) griffithi* Edwards and Haime also belongs thereto." (Free translation of original German diagnosis, [Stuckenberg, 1895, p. 191] by the writer.)

Equivalence of *Zaphrentoides* and *Triplophyllites* would result if it could be proved that Stuckenberg's statement is true that *Zaphrentoides* has an "endothecal tissue" (dissepiments) in the basal part of the corallites (Stuckenberg, 1895, p. 191). It is naturally probable that the Russian species studied by Stuckenberg have the structures assigned to them, but it is not necessarily true that *Z. griffithi,* which Stuckenberg mentioned only incidentally but which was subsequently (Schindewolf, 1938, p. 449) made the genotype of *Zaphrentoides,* also has dissepiments. Schindewolf (admittedly) and Stuckenberg (probably) based their concepts of *Z. griffithi* in part on Thomson's concept of that species, which he said (Thomson, 1881, p. 218) has "curved interseptal dissepiments." Probably Thomson's "curved interseptal dissepiments" are for the most part traces of tabulae, but some of them may represent dissepiments. Hill studied Thomson's figured specimen and concluded that *Z. griffithi* Milne-Edwards and Haime, Thomson, 1881 is a junior synonym of *Z. curvilinea* Thomson[3]. It is doubtful that *Z. griffithi* Milne-Edwards and Haime, Thomson, 1881 is conspecific with *Z. griffithi* Milne-Edwards and Haime, 1851.

In any case, Schindewolf's designation of *Z. griffithi* as the genotype of *Zaphrentoides* obviously must find basis upon Milne-Edwards and Haime's species and not upon Thomson's concept of that species. The fact is that, contrary to Schindewolf's statement (1938, p. 449), *Z. griffithi* is not "well known." Until *Zaphrentoides* is examined upon the basis of its genoholotype, its status will remain uncertain. If the genoholotype be lost, it is suggested that *Zaphrentoides* be allowed to lapse as far as it concerns "zaphrentid" nomenclature, except, of course, that it would then exist as a monotypic genus of unknown relationship.

(2) *Amplexi-Zaphrentis* Vaughan, 1906, was proposed as a subgenus of *Zaphrenthis* with three genosyntypes indicated, one of which, *Z. bowerbanki* Milne-Edwards and Haime, Thomson, 1883 (pl. 6, fig. 3), was chosen as genolectotype by Lang, Smith, and Thomas (1940, p. 16). Hill considered this "species" of Thomson's to be a junior synonym of *Z. curvilinea* Thomson, 1881. As pointed out above, Thomson's concept of *Z. griffithi* was considered by Hill to be representative of *Z. curvilinea.* If so, *Amplexi-Zaphrentis* is a junior synonym of at least part of the basis of Schindewolf's concept of *Zaphrentoides,* but there is no proof that the two genera are actually synonymous.

Carruthers (1908, p. 158) considered *Amplexi-Zaphrentis* to be a junior synonym of *Caninia.* It appears that this view would be acceptable from a study of Vaughan's diagnosis of *Amplexi-Zaphrentis* and from a study of the figured specimen (Vaughan, 1906, pl. 39, fig. 7), but the subsequent designation of a type for *Amplexi-Zaphrentis* seems to the writer probably to have changed the original concept of the genus.

(3) *Menophyllum* Milne-Edwards and Haime, 1850 is not known well enough to permit evaluation of the genus. It is thought to be nearly related to *Triplophyllites,* if not actually to be a senior synonym. Girty (1911, p. 28) once referred a specimen to

[3] Hill (1940, p. 126) believed that *Z. enniskilleni* Milne-Edwards and Haime (which "may well belong to the same generic group as *Z. delanouei*" [idem, p. 144]) should be referred to what is here called *Triplophyllites,* and that *Z. curvilinea* belongs in the same genus (idem, p. 140). Hill did not specifically mention the presence or absence of dissepiments in the discussions of the *Z. enniskilleni* and *Z. delanouei* species-groups, but she did say (idem, p. 143) that there are no dissepiments in *Z. curvilinea,* which she placed in the former group. On the other hand, illustrations of species (Thomson, 1881, pl. 3, figs. 4, 5) which Hill also placed in synonymy with *Z. curvilinea* Thomson seem to me to show sparse dissepiments in longitudinal section. Finally, Hill's illustration of *Z. curvilinea* (1940, pl. 7, fig. 2) appears to me to show dissepiments in the upper left corner, near the upper right corner, and at the lower left side.

this genus but subsequently (1915a, p. 23) stated that his concept of *Menophyllum* coincided with *Triplophyllum* Simpson; actually, it is to be inferred from this that his identification implies *Triplophyllites*. Until the genoholotype of *Menophyllum* is studied, it is suggested that the name not be applied to other Carboniferous "zaphrentids."

(4) *Triplophyllum* Simpson, 1900 was proposed with *Z. terebrata* Hall, 1883 as genotype. The single available specimen was not sectioned; in fact, only a side view was figured. Simpson figured *Z. dalei* Milne-Edwards and Haime and gave *Z. centralis* Milne-Edwards and Haime as an example, but he chose *Z. terebrata* as genotype apparently because that type was in the collections he studied and the others were not.

Girty (1915a, p. 23) erroneously cited "*T. centrale*" as the type species of *Triplophyllum*. Although it appears that subsequent studies correctly name the genotype, it so happens that *Z. terebrata* is not at all typical of the concept of *Triplophyllum* of authors exemplifying the generic group occurring in the Carboniferous.

The writer was unable to borrow the genoholotype of *Triplophyllum* for study, but excellent photographs were furnished by Dr. Winifred Goldring, some being reproduced here. Through the courtesy of Mr. H. E. Vokes, the writer was allowed to study and section four additional specimens (topotypes) of the species. So far as the writer is aware, these five are the only known specimens of *T. terebratum* (Hall). The material examined shows external details fairly well, but the internal preservation is very poor. A new description of this species is as follows.

Triplophyllum terebratum (Hall)

Plate 11, figures 1, 2; Plate 17, figures 16-18

Large, nearly straight, ceratoid; calyx very deep, secondary septa prominent wherever seen, primaries tending to form counterclockwise axial vortex; cardinal fossula inconspicuous in calyces, not confined to either concave or convex side, bounded by unfused adjacent metasepta, occupied by short cardinal septum; alar fossulae either absent or doubtfully identified septa withdrawn from axis in very old corallites, leaving calical floor formed by a tabula; epitheca thin, wrinkled, showing interseptal ridges and septal grooves faintly when unweathered; holotype with 48 major septa; another illustrated specimen with 42 primaries alternating with shorter secondaries, another with 44 primaries alternating with secondaries. In late ephebic stage (diameters 23 by 18 mm) primaries extend nearly to center, but are bunched; tabulae slope steeply into cardinal fossula; dissepiments abundant. In late neanic or early ephebic stage (diameters 11.5 by 11.5 mm) most primary septa extend to center, tendency toward axial vortex pronounced, cardinal fossula prominent, cardinal septum long, only one of alar fossulae discernible; secondary septa rudimentary or very short; dissepiments sparse.

Of the foregoing characters, the most important are the tendency toward formation of an axial vortex, the cardinal fossulae with free metasepta along the walls, the inconsequential alar fossulae, and the bunched groups of septa in late stages. Of less importance are the extremely deep calyx, the abberant position (with regard to curvature of the specimen) of the cardinal fossula, and the relatively long secondary septa associated with very long and free primary septa in the calyx.

These characters necessitate the recognition of two genera, *Triplophyllum* and *Triplophyllites*. *Triplophyllum* contains two American species—the Onondagan *T. terebratum* (Hall) and *T. edwardsi* (Nicholson). *Triplophyllites* contains the Carboniferous species heretofore thought typical of *Triplophyllum*.

The presence of dissepiments in *Triplophyllites* must be considered in relation to phylogenetic development, for this character is not consistent within the genus and may be difficult to prove in many specimens. Dissepiments are more apt to be found in stratigraphically older species, although they occur sparsely and irregularly and sometimes in modified form in younger species. Thus, although the writer's diagnosis is based in part upon a character of diminishing strength, the presence of the character in the series is of great taxonomic value.

Material.—Genoholotype of *Triplophyllum;* New York State Museum No. 3841/1; studied plesiotypes; American Museum of Natural History No. 4094/1. The present understanding of *Triplophyllites* is

based upon the types of *T. palmatus* and partly on Grove's hypotypes; University of Chicago (Walker Museum), Nos. 31560, 31546, 4704, 25192, 31570, and cotypes No. 4705. Other materials studied by Grove: holotype, Illinois State Geological Survey (Worthen collection) No. 2562; plesiotype, No. 2556.

Taxonomic possibilities.—*Triplophyllites* could be split into two subgenera, one of which would have the same name as that of the genus and would include *Triplophyllites* with the cardinal fossula on the concave side. The other subgenus would include those corals with the cardinal fossula on the convex side; this, then, would include corals corresponding to the concept of *Zaphrentoides* Stuckenberg. Unless *Zaphrentis reversa* Worthen should prove to belong to this group, the hypothetical subgenus is not known at present in North America.

Triplophyllites centralis (Milne-Edwards and Haime)

Plate 9, figures 1, 2

Zaphrentis centralis Milne-Edwards and Haime, 1851, Mus. histoire nat., Arch., vol. 5, p. 328, fig. 6.

Zaphrentis centralis, Milne-Edwards, 1860, Histoire nat. des coralliaires, t. 3, p. 336.

Zaphrentis centralis, Worthen, 1890, Illinois Geol. Survey, vol. 8, p. 72, pl. 9, figs. 1, 1a.

Zaphrentis centralis, Williams, 1900, Arkansas Geol. Survey, Ann. Rept. 1892, vol. 5, pp. 336, 337, 339-341.

Zaphrentis centralis, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 112.

Zaphrentis centralis, Keyes and Rowley, 1897, Proc. Iowa Acad. Sci., vol. 4, p. 30.

Zaphrentis centralis, Shepard, 1898, Missouri Geol. Survey, vol. 12, pt. 1, p. 122.

Triplophyllum centralis, Simpson, 1900, New York State Mus. Bull. 39, no. 8, p. 209.

Triplophyllum centralis, Simpson, 1902, New York State Univ. State Mus. Rept., vol. 54, no. 3, p. 209.

?Zaphrentis centralis, Girty, in Smith and Siebenthal, 1907, U. S. Geol. Survey Folio 148, p. 6.

Triplophyllum (Zaphrentis) centralis, Butts, 1922, Kentucky Geol. Survey, ser. 6, vol. VII, p. 84.

Zaphrentis centralis, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, p. 189.

?Zaphrentis sp. aff. *Z. centralis,* Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 181, 195.

Zaphrentis centralis, Cline, 1934, Bull. Amer. Assoc. Petrol. Geol., vol. 18, no. 9, p. 1152.

Externals.—Medium to large, curved ceratoid; epitheca thin, with encircling swellings, faint interseptal ridges, septal grooves; calyx deep, steep-walled; prominent cardinal fossula on concave side.

Transverse sections.—In late ephebic stage, about 40 major septa, radially arranged, withdrawn from center; septa of counter quadrants thickened; cardinal septum rudimentary; tabulae and dissepiments present; minor septa as septal ridges; alar fossulae indistinct or lacking.

In middle ephebic stage 36 thick major septa, all except very short cardinal septum extend to center or fuse about narrow cardinal fossula; alar fossulae much reduced; minor septa present; dissepiments sparse.

In early ephebic stage about 30 thin major septa, arrangement is radial in counter quadrants, pinnate in cardinal quadrants; alar fossulae well developed; cardinal septum very short; cardinal fossula narrow bounded by thin walls.

In neanic stage, 26 major septa, cardinal septum long, thick; cardinal fossula long, widest axially, with thick wall, composed of ends of pinnate septa in cardinal quadrants; septa in counter quadrants radial; alar fossula not pronounced; dissepiments very sparse.

Occurrence.—Localities 17-21, 70, 74, 84, 86, 87, 89, 97, 101-106.

Material.—Specimens studied, 4. Grove's hypotypes, University of Chicago No. 31560; Worthen's specimens, Illinois State Geological Survey (Worthen collection) Nos. 2570, 2563; primary types are presumably in Paris, France.

Remarks.—This species can be distinguished by the axial retreat of septa in the counter quadrants, by the failure of septa to curve about the cardinal fossula in adult stage, and by the relatively smooth but never spinose epitheca.

Triplophyllites cliffordanus (Milne-Edwards and Haime)

Plate 9, figures 3-5

Zaphrentis cliffordana Milne-Edwards and Haime, 1851, Mus. histoire nat. Arch., vol. 5, p. 329, pl. 3, fig. 5.

Zaphrentis cliffordana, Milne-Edwards, 1860, Histoire nat. des coralliaires t. 3, p. 337.

Zaphrentis cliffordana, Worthen, 1890, Illinois Geol. Survey, vol. 8, p. 75, pl. 10, figs. 1-1a (not 1b).
?Zaphrentis cliffordana, Whitfield, 1891, N. Y. Acad. Sci. Ann., vol. 5, p. 576, pl. 13, figs. 1-3.
?Zaphrentis cliffordana, Whitfield, 1895, Ohio Geol. Survey, vol. 7, p. 465, pl. 9, figs. 1-3.
Zaphrentis cliffordana, Grabau and Shimer, 1909, North American Index Fossils, vol. 1, p. 58.
Zaphrentis cliffordana, Weller, 1909, Geol. Soc. America Bull., vol. 20, p. 272, pl. 10, figs. 18-19.
Zaphrentis cliffordana, Bassler, 1912, Proc. U. S. Nat. Mus., vol. 41, p. 219.
Triplophyllum cliffordana, Butts, 1922, Kentucky Geol. Survey, ser. 6, vol. VII, pp. 52, 55, 58, 59, 71.
Triplophyllum (Zaphrentis) cliffordana, Butts, 1922, Kentucky Geol. Survey, ser. 6, vol. VII, p. 53.
Triplohpyllum [*sic*] *cliffordana,* Butts, 1922, Kentucky Geol. Survey, ser. 6, vol. VII, p. 56.
Zaphrentis (Triplophyllum)? cliffordana?, Butts, 1926, Alabama Geol. Survey, Sp. Rept. 14, p. 170, pl. 54, fig. 7.
Zaphrentis cliffordana, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 63, 97, 148, 163, 175, 177, 187, 195.
?Zaphrentis cliffordana, Laudon, 1931, Iowa Geol. Survey, vol. 35, pp. 380, 393, 398-402, 414, 427, 429 [in part].
Zaphrentis wortheni, Laudon, 1931, Iowa Geol. Survey, vol. 351, p. 427.
?Triplophyllum clifforadanum, Grove, 1935, Am. Midland Naturalist vol. 16, p. 344; pl. 8, figs. 4, 5; pl. 11, figs. 13, 14, 16 (not 12, 15).

Externals.—Small to medium size, sharply curved ceratoid, commonly carinate near apex at cardinal and counter positions; epitheca with encircling rugae, faint interseptal ridges and septal grooves; calyx moderately deep, steep-walled; cardinal fossula on concave side; minor septa in most mature stages.

Transverse sections.—In ephebic stage (diameters 11.2 by 9.0 mm) are 30 much dilated major septa, of which there are 9 on either side of counter septum in counter quadrants; minor septa absent; cardinal septum long; tabulae sparse; dissepiments not observed.

In very late ephebic stages, cardinal fossula becomes more apparent by retreat of cardinal septum.

Occurrence.—Localities 14, 16, 30-38, 40-43, 53, 60, ?66, 67-69, 73, 88, 91-96, 107. The original material of Milne-Edwards and Haime came from locality 21 (New Providence shale) and from Mammoth Cave and Grayson County, Kentucky. Material has been listed by Whitfield (1891, 1895) from the Maxville limestone at Maxville and Newtonville, Ohio. The Maxville limestone and the beds near Mammoth Cave and in Grayson County are much younger than beds at locality 21, hence, more than one species is probably represented. The only undoubted specimens seen by the writer are from localities 16 and 35.

Material.—Grove's hypotypes, University of Chicago No. 4704, not studied; the primary types are presumably in Paris, France; the material used in this review is State University of Iowa No. 9902.

Remarks.—This species is characterized externally by the small curved, commonly carinate corallites (3 or 4 cm high, calyx 1.5 to 2 cm in diameter); internally by the rather straight thick major septa, persistently long cardinal septum, and late insertion of minor septa.

The writer has been unable to find the sections from which Grove made the figures (Grove, 1935, pl. 11, figs. 13, 14, 16) hence detailed study could not be made of them, but the writer does not include the other illustrated specimens (idem, pl. 11, figs. 12, 15) in *T. cliffordanus.*

Triplophyllites exiguus (Miller)

Plate 10, figures 1-7

Zaphrentis exigua Miller, 1891, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 11, pl. 1, figs. 19, 20. Adv. Sheets.
Zaphrentis exigua, Miller, 1892, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 621, pl. 1, figs. 19, 20.
?Zaphrentis sp. Worthen, 1873, Illinois Geol. Survey, vol. 5, p. 278.
Zaphrentis cliffordana?, Worthen, 1890, Illinois Geol. Survey, vol. 8, p. 75?, pl. 10, fig. 1b (not 1, 1a).
Zaphrentis wortheni Weller, 1909, Geol. Soc. America. Bull., vol. 20, pp. 273, 274, pl. 10, figs. 20, 21.
Zaphrentis (Triplophyllum) wortheni, Butts, 1922, Kentucky Geol. Survey, ser. 6, vol. VII, p. 71.
Zaphrentis wortheni, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 164, 195.
?Zaphrentis sp. cf. *Z. wortheni,* Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, p. 97.
Non *Zaphrentis wortheni,* 1931, Laudon, Iowa Geol. Survey, vol. 35, p. 427.
Triplophyllum welleri Grove, 1935, Am. Midland Naturalist, vol. 16, no. 3, p. 347, pl. 8, fig. 9; pl. 13, figs. 21-25.

Externals.—Curved ceratoid; epitheca rather smooth, with sparse encircling rugae; calyx deep, sloping toward cardinal quadrants; cardinal fossula on concave side; major septa extend upon floor of calyx but do not reach center; minor septa appear as septal ridges.

Transverse sections.—In late ephebic state, thin major septa extend three-fourths of the radius; cardinal fossula prominent; minor septa very short.

In middle ephebic stages, cardinal fossula may be curved, with thickened area at inner end where thin major septa meet; minor septa as septal crests; cardinal septum very short.

In late neanic or early ephebic stage cardinal fossula is narrow, major septa fuse around fossula; alar pseudo-fossula present; cardinal septum rather long; no minor septa; tabulae present in all stages; dissepiments sparse.

Occurrence.—Localities 1, 14, 15, ?52, 67, 90.

Material.—Specimens studied, 4. Miller's figured specimen (here designated the holotype) University of Cincinnati No. 7391; Weller's cotypes, University of Chicago No. 4705; Worthen's specimen (1890, pl. 10, fig. 1b), Illinois State Geological Survey (Worthen collection) No. 2570—the others shown in figs. 1, 1a of pl. 10 are missing.

Remarks.—The above description is modified from data presented by Grove (1935, pp. 347, 348). *Zaphrentis wortheni* Weller was renamed *Z. welleri* by Grove because the former name is a junior hononym of *Z. wortheni* Nicholson.

This species can be distinguished from *T. cliffordanus* by the thin septa (rather than thick short septa), by the presence of minor septa in early ephebic stage, and by the weakly developed cardinal fossula present in an ephebic stage. The shape of the fossula of *T. exiguus* in early ephebic stage is the same as that in adult stages of *T. cliffordanus,* according to Grove (1935, p. 348).

Worthen's specimen has the characteristic reddish-brown color of many Fern Glen fossils; the locality on the label is merely "Kinderhook, Monroe County, Illinois."

Zaphrentis exigua of Keyes (1894, p. 112) and Moore (1928, pp. 97, 154, 195) are omitted from the synonymy because specimens cannot be located for checking; it is highly improbable that these citations are equivalent to *Z. exigua* Miller which is based upon a single young specimen. In the same lot with this specimen, but of uncertain value as types (because of lack of numbers or other identifying data), were specimens of *Meniscophyllum minutum* and *Hapsiphyllum* (n. subgen.) n. sp.

TRIPLOPHYLLITES IDA (Winchell) emend. Easton

Plate 11, figures 3-6; Plate 17, figures 6, 7

Zaphrentis Ida Winchell, 1865, [in part], Acad. Nat. Sci. Philadelphia Proc., p. 111.

Non *Zaphrentis Ida?,* Winchell in Safford, 1869, Geology of Tennessee, pp. 441, 444.

?*Zaphrentis Ida?,* Winchell, 1870, Am. Philos. Soc. Proc., vol. 11, p. 247.

Zaphrentis Ida, Kindle, 1899, Bull. Am. Paleontology, vol. 3, bull. 12, pp. 12, 176.

Triplophyllum cliffordanum var. *hespere* Grove, 1935, Am. Midland Naturalist, vol. 16, p. 346, pl. 8, fig. 6; pl. 18, figs. 9-11.

Externals.—Curved ceratoid to trochoid; epitheca moderately thick, with encircling striae and rugae, rejuvenation and associated geniculation common, interseptal ridges faint; calyx apparently deep. Greatest diameter of holotype, 27 mm; length of convex side, 60 mm (incomplete).

Transverse section.—Holotype in middle ephebic stage (diameters 10.4 by 10.7 mm) with approximately 26 major septa greatly thickened, extending nearly to center; cardinal septum rather thin, long, occupying narrow fossula on concave side; tabulae sparse.

Paratype in late ephebic stage (diameters 15.6 by 16.4 mm), with 31 major septa; cardinal septum very short, thin; all septa in cardinal quadrants thin; counter septum longest, it and septa of counter quadrants much thickened, some notably thickened near tips; minor septa rudimentary; tabulae sparse, four intersections in fossula, one across center of corallite.

Tangential section.—Edges of tabulae concave upwards, 3 to 7 in 5 mm.

Occurrence.—Localities 6, 12, 13.

Material.—Specimens studied, 4. Holotype, University of Michigan No. 5396; paratype, University of Michigan No. 23237; third original cotype *(Amplexus*

rockfordensis), University of Michigan No. 23236; Grove's cotypes, University of Chicago No. 31570; figured plesiotype, Illinois State Geological Survey No. 3501; other specimens, University of Michigan No. 5199, Illinois State Geological Survey No. 3515.

Remarks.—One of the three cotypes is *Amplexus rockfordensis* Miller and Gurley. The writer selects the largest of the other two original specimens as the holotype and has based the above description on it and the smaller specimen (now called a paratype).

Winchell's remarks regarding the calyx are misleading; his ideas were almost certainly obtained by grinding down the paratype because none of the specimens possessed a clean calyx. The three specimens (University of Michigan No. 23135) identified by Winchell as *Zaphrentis Ida?* in 1869 are actually *Triplophyllites dalei.* The writer also questions the identification of specimens described by Winchell in 1870. They cannot now be found but are probably referable to *T. dalei.*

The variety of *T. cliffordanus* erected by Grove is identical with *T. ida.* The writer considers the characters to be of specific rank.

Genus Hapsiphyllum Simpson emend. Easton

Hapsiphyllum Simpson, 1900, New York State Mus. Bull. 39, vol. 8, p. 203.

Diagnosis.—Simple, curved, conical; may be flattened on one side; calyx moderately deep; cardinal fossula bordered by edges and by fused ends of major septa; alar fossulae indistinct except in young stages; cardinal septum tends to be shortened in ontogenetically younger species; minor septa may be fused to side of majors toward cardinal fossula; counter septum may be joined on each side by a minor, giving tripartite structure; counter quadrants accelerated; tabulae present; dissepiments absent.

Genotype. — *Hapsiphyllum calcariforme* (Hall).

Occurrence. — Carboniferous, especially Lower Carboniferous, of North America, Europe, and Asia.

Remarks.—Schindewolf considered *Hapsiphyllum* as a subgenus of *Zaphrentoides,* a procedure in which the writer does not agree (for reasons stated under the discussion of *Triplophyllites*). For a detailed discussion of the morphology of the genotype, see Schindewolf (1938, pp. 445-447).

Subgenus Hapsiphyllum Simpson, emend. Easton

Zaphrentoides (Hapsiphyllum) Schindewolf, 1938 [in part], Jahr. Preuss. Geol. Landesanst., vol. 58, p. 449.

Diagnosis.—*Hapsiphyllum* with the cardinal fossula on the concave side of the corallite.

Type.—*Hapsiphyllum calcariforme* (Hall).

Remarks.—The type is the only species at present known from North America.

Subgenus Homalophyllites Easton, new subgenus

Homalophyllum Simpson, Grove, 1935 [in part], Am. Midland Naturalist, vol. 16, No. 3, p. 353.

Zaphrentoides (Zaphrentoides) Schindewolf, 1938 [in part], Jahr. Preuss. Geol. Landesanst., vol. 58, p. 450.

Diagnosis.—Hapsiphyllum with the cardinal fossula on the convex side of the corallite.

Type.—*Lophophyllum calceola* White and Whitfield, 1862.

Remarks. — *Homalophyllum* Simpson, 1900 was based on the flattening of the cardinal side of the coral, a feature to which Grove (1935) attributed considerable importance, naming these corals "calceolid" corals. The writer agrees with Schindewolf (1938, p. 451) that the flattening is not of great taxonomic value, occurring as it does among several certainly unrelated groups. However, the writer does not agree with Schindewolf that the flattening represents the area by which the corals were attached, but thinks rather that the flattening may have been caused by the coral's lying recumbent upon that side. Schindewolf also discovered (idem, p. 451) by examination of type material of *Zaphrentis ungula* Rominger, 1876, the genotype of *Homalophyllum,* that *H. calceolum* of authors does not belong to *Homalophyllum.*

Inasmuch as *Homalophyllum* is well established in the literature of the American Carboniferous, it is felt that the name

Homalophyllites is a felicitous choice for the subgenus to which the writer considers these corals to belong.

Hapsiphyllum (Homalophyllites) calceolus (White and Whitfield)

Plate 4, figures 4-7; Plate 16, figures 23-25

Lophophyllum calceola White and Whitfield, 1862, Boston Soc. Nat. History Proc., vol. 8, p. 305.

Zaphrentis calceola, White, 1880, U. S. Geol. and Geog. Survey Terr., 12th Ann. Rept., pt. 1, Contr. Invertebrate Paleontology no. 8, p. 156, pl. 39, figs. 6a-d; advance printing.

Zaphrentis calceola, White, 1883, U. S. Geol. and Geog. Survey Terr., 12th Ann. Rept., pt. 1, Contr. Invertebrate Paleontology, no. 8, p. 156, pl. 39, figs. 6a-d.

Zaphrentis calceola, Rowley, 1889, Am. Geologist, vol. 3, p. 275.

Amplexus corniculum Miller, 1891, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 9. Adv. Sheets.

Amplexus corniculum, Miller, 1892, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 619.

Zaphrentis calceola, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 110.

Zaphrentis calceola, Keyes and Rowley, 1897, Proc. Iowa Acad. Sci., vol. 4, p. 30.

Zaphrentis calceola, Van Tuyl, 1925, Iowa Geol. Survey, vol. 30, pp. 104, 122, 123.

Zaphrentis calceola, Moore, 1927, Am. Assoc. Petrol. Geol. Bull. vol. 11, no. 2, p. 1329.

Homalophyllum calceolum, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 63, 128, 154, ?183, 185, 186, 191, 195, ?233, 224, 248.

Zaphrentis calceola, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, p. 195.

Zaphrentis calceola, Laudon, 1931, Iowa Geol. Survey, vol. 35, p. 393.

Zaphrentis cliffordana, Laudon, 1931, Iowa Geol. Survey, vol. 35, pp. 427, 429 in part.

?Homalophyllum calceolum, Cline, 1934, Am. Assoc. Petrol. Geol. Bull., vol. 18, no. 9, p. 1144.

Homalophyllum calceolum, Grove, 1935, Am. Midland Naturalist, vol. 16, no. 3, p. 354; pl. 9, figs. 20-24; pl. 13, figs. 1-6.

Homalophyllum calceolum, Hill, 1937, Royal Soc. Queensland Proc., vol. 48, p. 25, text-fig. 5 on p. 24.

Externals.—Small, curved, ceratoid, increasingly flattened proximally on convex side; epitheca moderately thick, with interseptal ridges, septal grooves, and very deep angular encircling constrictions; calyx moderately deep, with pronounced axially enlarged cardinal fossula on convex side; septa distally produced around axial portion of fossula, fused on axial ends, reinforced by sclerenchyme; cardinal septum very short; minor septa present.

Transverse sections.—In late ephebic stage (diameters 7.9 by 7.2 mm) major septa number 30; minor septa very scarce, as septal ridges; tabulae sparse.

In late neanic stage (diameters 3.4 by 2.0 mm) major septa number 21, with thin majors inserted between most neighboring thick septa; cardinal septum long, bifurcate at tip.

In very early neanic stage (diameters 2.4 by 1.1 mm) thick major septa number 14; no thin majors present; cardinal and counter septa confluent.

Longitudinal section. — Tabulae thin, broadly arched distally, about 10 in 5 mm.

Occurrence.—Localities 1, 8, 16, 22, 30, 35, 38, 55, 57, 62, ?71, 72, 73, 75, ?76, 77-79, 84, 85. Grove lists only "Chouteau limestone, Sedalia, Missouri," as the horizon and range of this species, having apparently been unable to verify its reported occurrence at other places. White reported it from the base of the Burlington and also below the Burlington limestone at and near Burlington, Iowa. Rowley reported the species from the "upper Chouteau" (unrestricted), 4 miles east of Curryville, Missouri; lower Burlington at Louisiana, Missouri; and upper Burlington 2 miles north of Curryville, Missouri. Keyes listed the species as occurring in the Kinderhook limestone at Sedalia, Clarksville, Hannibal, and Louisiana, all in Missouri.

Material.—Specimens studied, 50. Two cotypes (unavailable for study), American Museum of Natural History No. 4993/1; Grove's hypotype, University of Chicago No. 31584a; White's pleisiotypes (unstudied), United States National Museum Nos. 9330, 9331; specimens figured herein, University of Cincinnati No. 24311 and University of Missouri not numbered; other material, American Museum of Natural History Nos. 6365/2, 6365/3, University of Missouri No. 1139 and not numbered, University of Cincinnati No. 24396 (which was a paratype of *Neozaphrentis tenella*), Illinois State Geological Survey (Worthen collection) No. 4302, and University of Chicago No. 1282.

Remarks.—The neanic sections described above are from material collected from the Burlington limestone. These sections differ from the neanic section (slightly younger) figured by Grove (1935, pl. 13, fig. 6) in that they do not have the open central area and accompanying short septa.

Hapsiphyllum (Homalophyllites) pinnatus Easton n. sp.

Plate 7, figures 6-8; Plate 16, figures 11-15

Zaphrentis tenella Miller, 1891, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 11, Adv. Sheets.

Zaphrentis tantilla Miller, 1891, [in part], idem, p. 11.

Zaphrentis tenella, Miller, 1892, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 621.

Zaphrentis tantilla, Miller, 1892, [in part], idem, p. 621.

Zaphrentis tantilla, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 111. [?]

Description.—Simple, sharp pointed, curved ceratoid corals with geniculate tip bent to right when cardinal fossula is oriented downward; calyx moderately deep, calicular pit connected with very deep, prominent cardinal fossula generally on convex side; septa increasing in length from upper edge of calyx toward floor; major septa 22 in calyx of holotype at late ephebic stage, alternating with short minor septa as septal ridges; epitheca very thick, smooth, obscuring interseptal ridges.

Holotype large, 20 mm long, 8.0 mm in diameter at calyx; most specimens about 13 mm long, 6 mm in diameter at calyx, with 17 or 18 major septa.

Holotype in late ephebic stage (diameter 8.0 mm) with radially arranged septa; cardinal septum only slightly recessive, three major septa grouped on each side, followed by alar septa, a pair of majors, four majors, and cardinal septum similar to others.

In middle ephebic stage (diameter 5.8 mm), septa in quadripartite grouping with septa of cardinal quadrants pinnate; cardinal septum fairly long; without axial pit connecting with cardinal fossula; a pair of major septa on either side of cardinal septum, followed by single major which may or may not extend to center; alars somewhat longer than neighboring septa, followed by pair, to which third is more or less joined; single majors on either side of the counter, which extends almost to axis.

In early ephebic stage (diameter 1.2 mm), 13 or 14 septa; uncertain because of imperfect preservation in studied specimen.

In early neanic stage (diameter about 0.9 mm) 9 septa; cardinal long, in prominent pseudofossula, confluent with counter; alar septa prominent.

Longitudinal section.—Thin tabulae rising upward axially, about 1 mm apart.

Comparison.—This species differs from *H. (Homalophyllites) calceolus* in being generally smaller, having a shorter cardinal fossula in which the cardinal septum reaches the axis, in having fewer septa, and in lacking the flattening of the cardinal (convex) side.

Occurrence.—Holotype and paratypes, locality 9; other specimens, locality 1.

Material.—Specimens studied, 10. Holotype, University of Cincinnati No. 24393; paratypes, University of Cincinnati No. 24310; plesiotypes, University of Cincinnati Nos. 24390 (formerly cotype of *Z. tantilla*), 24408 (as paratypes of *Z. tenella*), and 24409 (as cotype of *Z. calycula* Miller); other plesiotypes (which were in the same lot as the type of *Z. exigua* Miller), University of Cincinnati No. 24391; figured plesiotype, Illinois State Geological Survey No. 3502.

Remarks.—This species is most interesting because of the persistence of the long cardinal septum into late stages and the persistent pinnate arrangement of septa in the cardinal quadrants.

Genus Neozaphrentis Grove, 1935

Diagnosis.—"Small to large conical to sub-cylindrical solitary corals, curved or nearly straight. Exterior rugose and may be concentrically wrinkled and undulatory; often annulated from rejuvenescence or periodic growth. Calyx shallow to deep. Septa variable in thickness, smooth, non-carinate, straight or distally wavering; in two cycles, but the secondaries may be rudimentary. Not more than 60 major septa, not marginally contracted, extending to the center of the calyx where they may fuse, or disappearing a short distance before reaching the center, which is then occupied by a small open or tabulate area. Cardinal septum recessive in post-neanic stages. Cardinal fossula well developed, variable in position, sub-central or extending to the margin. Tab-

ulae few or numerous, partitioning the whole of the corallum; dissepiments few, and not arranged in definite zones. No columella or central columelloid structure resulting from fusion of septa." (Grove, 1935, pp. 358, 359).

Genotype.—Neozaphrentis tenella (Miller), 1891.

Occurrence.—Silurian to Carboniferous in many parts of the world.

Neozaphrentis tenella (Miller) emend. Easton

Plate 4, figures 1-3; plate 16, figures 26-30

Zaphrentis tenella Miller, 1891, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 11, pl. 1, figs. 17, 18, Adv. Sheets.

Zaphrentis tenella, Miller, 1892, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 621, pl. 1, figs. 17, 18.

Zaphrentis tenella, Moore, 1927, Amer. Assoc. Petrol. Geol., Bull. vol. 11, no. 2, p. 1329.

Zaphrentis tenella, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 63, 67, 93, 97, ?128, 154, 158, 195.

Neozaphrentis tenella, Grove, 1935, Am. Midland Naturalist, vol. 16, pp. 360-361, pl. 9, figs. 6-8, pl. 13, figs. 7-14.

Externals.—Small, curved conical, with apical end commonly bent to left when cardinal fossula is orientated downward; epitheca with bourrelets, faint interseptal ridges, septal grooves; calyx moderately deep, with cardinal fossula irregularly located though generally on convex half; holotype with 27 septa, pinnate in cardinal quadrants, radial in counter quadrants; alar pseudo-fossulae present; cardinal septum short, on right side of long deep fossula; septal grouping quadripartite; counter septum long, neighboring septa tend to be pinnate; dissepiments not observed; tabulae widely spaced, sloping toward cardinal quadrants. In a paratype, major septa number 25 alternating with secondary septa as septal ridges; counter septum extends farthest distally in calyx. Another paratype has 26 major septa; counter septum long, thick, with pronounced distal boss on axial end; neighboring septa of counter quadrants pinnate. In early ephebic stage of broken paratype, tabulae reflexed into cardinal fossula.

Transverse sections.—Septa radially arranged in neanic stage, with axial edges fused around central space; in later stages cardinal fossula merges with central space; cardinal septum becomes recessive by ephebic stage.

Occurrence.—The types came from locality 9; specimens reported from localities 38, 48, 50, 51, 52, 55, 56, 58. Keyes (1894, p. 111) cites the locality as "Kinderhook limestone: Sedalia, Louisiana," Missouri, but the explanation to plate XIII reads "Keokuk limestone." According to McQueen,[4] there are no specimens of this species preserved in the Missouri Geological Survey collections.

Material.—Specimens studied, 47. Holotype, University of Cincinnati No. 3360; figured paratypes, University of Cincinnati No. 3360a; unfigured paratypes, University of Cincinnati No. 24397; plesiotypes, University of Cincinnati Nos. 24392, 24405 (as paratype of *A. corniculum* Miller); Grove's hypotypes, University of Chicago No. 31593; other specimens, University of Missouri No. 2236.

Remarks.—The writer has not included *Zaphrentis tenella,* Keyes, 1894, p. 111, pl. 13, fig. 10 in the synonymy because the description is inadequate and the figure is not similar to any of the type specimens. Among the paratypes are two specimens of *Meniscophyllum minutum,* one specimen of *Homalophyllum calceolum,* one specimen of *Rotiphyllum* n. sp., one specimen of *Amplexus corniculum,* eight specimens of *H. (H.) pinnatus,* and 20 specimens of *Neozaphrentis tenella.* Twenty poor specimens were not identified.

Miller did not publish designations of types for this species, but his figured specimen is listed as the holotype in his collection and other specimens are listed as paratypes. The writer accepts this as designation of types in this instance.

Genus Meniscophyllum Simpson, 1900, emend. Easton

Meniscophyllum Simpson, 1900, New York State Mus. Bull. 39, vol. 8, p. 199.

?Heptaphyllum Clark, 1924, Geol. Mag., vol. 61, p. 416.

Non *Meniscophyllum* Grabau, 1928, Palaeontologia Sinica, ser. B, vol. 2, fasc. 2, p. 138.

Emended diagnosis.—Simple rugose corals, small, curved, conical, without spines; cardinal fossula fairly prominent, situated on convex side; counter fossula large, con-

[4] McQueen, H. S., correspondence, August 26, 1942.

taining two to four possibly free septa; other septa fused into crescentic ring; tabulae thin; dissepiments absent; minor septa occur only in very advanced stages. In longitudinal section fused tips of septa form solid structure on cardinal side with tabulae occupying axial position.

Genotype. — *Meniscophyllum minutum* Simpson, 1900.

Occurrence.—Lower part of Chouteau limestone (unrestricted), Sedalia, Missouri; (?) Rockford beds, Rockford, Indiana; (?) Lower Carboniferous shales (Z_1), County Sligo, Ireland.

Remarks.—*Heptaphyllum* closely resembles *Meniscophyllum* in adult stages, but the writer has not found stages as early as those figured by Clark, therefore, the equivalence of the two genera is disputable. Hill (1937, p. 25) grouped *Meniscophyllum* with *Allotropiophyllum,* but these two genera are dissimilar in the light of the present emendation. Hill (1940, p. 145) compared *Meniscophyllum* with *Zaphrentis delanouei,* but the morphology of *Meniscophyllum* had not been properly established at that time.

Meniscophyllum minutum Simpson

Plate 5, figures 1-4; Plate 16, figures 20-22

Meniscophyllum minutum Simpson, 1900, New York State Mus. Bull. 39, vol. 8, pp. 200, 201, figs. 1-4 on p. 200.

Meniscophyllum minutum, Grabau, 1928, Palaeontologia Sinica, ser. B., vol. 2, fasc. 2, pp. 138, 139, 149.

Meniscophyllum, Hill, 1937, Royal Soc. Queensland Proc., vol. 48, p. 24, text fig. 14.

Meniscophyllum minutum, Sanford, 1939, Am. Jour. Sci., vol. 237, p. 322, fig. $10B_1$, $10B_2$.

Externals.—Small, ceratoid to trochoid; epitheca thick, smooth, generally weathered to reveal interseptal ridges; calyx deep, sharply concave with 17 to 19 majors almost reaching center; cardinal septum and possibly first septum on left in fossula on convex side; calyces of very old specimens exceedingly deep with minor septa rudimentary; some septa on counter side either short and free or long and fused to stereotheca of cardinal side.

Transverse sections.—In section just below calyx (diameters 7.2 by 6.5 mm), 18 majors, 2 on counter side almost fused to other 16, all having tips fused into crescentic solid area.

In slightly later stage of small specimen (4.8 mm reconstructed), at least 3 and possibly 4 free septa on counter side with 15 or possibly 16 fused septa elsewhere.

In late neanic section (diameters 1.5 by 2.0 mm), 11 septa arranged in four groups with large fossula in cardinal position.

Longitudinal section.—Tabulae convex peripherally, sloping obliquely downward toward epitheca, concave in axial region; septal traces thick on convex side where their horseshoe shaped arc of fusion (as seen in transverse section) is cut.

Occurrence.—Although Simpson stated (1900, p. 200) the type locality to be "Lower Carbonic, Missouri," the labels and the type catalogue read[5] "Kinderhook beds, Rockford, Indiana." The writer has not found duplicates in any known collections of Rockford material. The specimens studied are from localities 7 and 9.

Material.—Specimens studied, 51. Holotype, No. 3540/2 (Simpson, fig. 3); paratype, No. 3540/3 (Simpson, fig. 4); paratype, No. 3540/1 (Simpson, fig. 2); all in New York State Museum. Studied material: University of Cincinnati Nos. 3359a, 24394, 24395 (two specimens which were paratypes of *Z. tenella*), 24407 (as paratype of *A. corniculum* Miller), University of Missouri Nos. 362, 1041, 1044, 1046, not numbered.

Remarks.—Because Simpson did not select a holotype, the writer designates the figured thin-section (Simpson, 1900, fig. 3 on p. 200) as the holotype. It is possible that fig. 4 (idem) was made from a different section of the same specimen, but this cannot be substantiated. The specimen represented in fig. 1 (idem) was never entered in the original collections,[6] but it may have been one of the sectioned specimens.

Grabau (1928, p. 139) wrongly identified the position of the cardinal fossula because he assumed that the sketchy figure (Simpson, 1900, fig. 1) was in error regarding the location of the interseptal ridges.

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[5] Correspondence, Winifred Goldring, November 17, 1942.

[6] Correspondence, Winifred Goldring, November 17, 1942.

Genus Clinophyllum Grove, 1935, emend. Easton

Small to medium size, curved conical corals; calyx usually deep and steeply inclined; epitheca thick; septa thick, tapering; counter septum longest, cardinal septum next longest; alar septa shortest, small, lying in alar pseudo-fossulae; septa reaching center in young but not later stages, pseudopinnately arranged; tabulae sparse, complete, rather strong, steeply inclined cardinally; dissepiments lacking.

Genotype. — *Clinophyllum chouteauense* (Miller), 1891.

Occurrence.—Chouteau limestone (unrestricted) of Missouri; shale beneath Rockford limestone in Indiana.

Remarks.—The above diagnosis is from Grove (1935, pp. 364, 365) with the modification that the calyx is not always steeply inclined.

Clinophyllum chouteauense (Miller)

Plate 6, figures 1-3; Plate 16, figures 34-38

Zaphrentis chouteauensis Miller, 1891, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 10, pl. 1, figs. 11, 12, Adv. Sheets.

Amplexus corniculum Miller, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 9, Adv. Sheets.

Zaphrentis chouteauensis, Miller, 1892, Indiana Dept. Geol. Nat. Res., 17th Ann. Rept., p. 620, pl. 1, figs. 11, 12.

Amplexus corniculum, Miller, 1892, [in part], idem, p. 619.

Zaphrentis chouteauensis, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 112.

Zaphrentis chouteauensis, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2. vol. 21, pp. 53, 97.

?Zaphrentis sp. cf. *Z. chouteauensis,* Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, p. 120.

Clinophyllum chouteaunse [*sic*], Grove, 1935, Am. Midland Naturalist, vol. 16, p. 365.

C[*linophyllum*] *chouteauensis,* Grove, 1935, idem, p. 366.

Externals.—Medium size, curved, ceratoid, slightly flattened normal to counter-cardinal plane; epitheca smooth to faintly marked by interseptal ridges, not thick; calyx steeply tilted proximally toward cardinal septum; septa thick, extending upon tabulae in floor; counter septum thickest and longest, occupying fairly prominent pseudo-fossula; alar septa may be slightly shortened; tabulae tilted approximately parallel with rim of calyx.

Transverse sections.—Septa radially arranged in neanic stage, extending to center; tabulae possibly absent; cardinal fossula weak, if present; cardinal and counter septa thicker than others.

Septa in ephebic stage become unequally thickened but fail to reach axis as calyx expands; tabulae present.

Longitudinal section.—Tabulae thick, widely spaced, tabular density 11 or 12 per cm.

Occurrence.—Localities, 2, 7, 10, 11, 47, 53, 54.

Material.—Specimens studied, 26. Holotype, University of Cincinnati No. 3916; figured paratype, University of Cincinnati No. 24308; unfigured paratype, University of Cincinnati No. 3917; Grove's hypotypes, University of Chicago Nos. 3158, 9679; tentatively identified specimens, University of Missouri Nos. 370, 1050, 1148; United States National Museum not numbered.

Remarks.—The specimen figured by Miller (1892, pl. 1, figs. 11, 12) is here designated the holotype. One of the original cotypes proves to be *Amplexus corniculum.*

Clinophyllum excavatum Easton, n. sp.

Plate 6, figures 4-6; Plate 16, figure 39

Amplexus corniculum Miller, 1891, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 9, Adv. Sheets.

Zaphrentis calyculus Miller, 1891, [in part], idem, p. 10.

Amplexus corniculum, Miller, 1892, [in part], Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 619.

Zaphrentis calyculus, Miller, 1892, [in part], idem, p. 620.

Externals.—Curved ceratoid, rather rapidly expanding near calyx; calyx extremely deep, slightly inclined; epitheca smooth, except for striae, occasionally rugae.

Transverse sections.—In late ephebic stage (diameters 11.6 by 9.6 mm), 21 primary septa, counter septum longest, two probable alars next longest, remainder of about equal length; tabulae sparse, developed only near periphery; epitheca extremely thick.

In middle ephebic stage (diameters 10.1 by 9.4 mm), number of septa not determined because of fusion into extremely thick epitheca; both the counter and cardinal septa long, latter somewhat thicker.

In late neanic stage (diameters 5.5 by 4.7 mm), 19 major septa, counter, cardinal, and two others in cardinal quadrants meet at tabular intersection near axis of coral.

Longitudinal section.—Not ground because of remarkably deep calyx.

Comparison.—This species can be distinguished by the extraordinarily thick epitheca, very deep calyx, lack of strong inclination of calyx, and by the tendency toward distal flaring of corallite.

Occurrence.—Localities 1, 2, 7.

Material.—Specimens studied, 9. Holotype and paratypes, University of Missouri not numbered; ideotypes, University of Cincinnati Nos. 24309, 24319 and University of Missouri No. 1052 and not numbered.

Appendix to the Hapsiphyllidae
Genus and species unidentified

Plate 17, figures 13, 14

Description.—Curved, trochoid, simple; epitheca spinose, flattened on convex side; calyx deep, with 38 major septa, cardinal fossula on convex side; dissepiments in three or four rows, concentric.

Early ephebic stage, at diameter of about 7 mm, short cardinal septum flanked on one side by 8 thick major septa and one other side by 7 thick septa; axial ends of each group fused; counter septum long, thin, flanked on either side by 5 shorter thin major septa with ends axially free; tabulae arched rather sharply distally.

Occurrence.—Locality 1.

Material.—Specimen studied, 1. University of Chicago No. 31591.

Remarks.—This specimen has the shape, spines, tabulae, dissepiments, and apparent septal arrangement of *Allotropiophyllum* Grabau, 1928, but in that genus the septa of the counter quadrants from a continuous inner wall and the septa of the cardinal quadrants are free. Thus, the primary symmetry is reversed. There can be no doubt that this specimen is the reverse of *Allotropiophyllum* because study of interseptal ridges bears out the orientation as seen in sections. *Allotropiophyllum* as interpreted by Hill (1940) differs from the diagnosis given by Grabau in that there are no dissepiments. Under the circumstances it is not advisable to assign this specimen to any existing genus, and a new group should not be erected to contain it until further material is available.

Genus Amplexus Sowerby, 1814

"Simple cylindrical Rugose corals with thin, short septa which are fully developed only on the upper surfaces of the tabulae, but above these extend progressively a shorter distance from the epitheca. The tabulae are widely spaced, flat and complete, and there are no dissepiments." (Hill, 1940, p. 147.)

Genotype.—*Amplexus coralloides* Sowerby, 1814.

Occurrence.—Supposedly from Silurian to Permian in many parts of the world.

Remarks.—Hill (1940, pp. 147, 148) regards *Amplexus* of authors as a polyphyletic group. *Amplexus rockfordensis* Miller and Gurley has thickened septa in the cardinal quadrants in as late as the ephebic stages, and thus differs from the genotype which has thin septa. Ordinarily, such a pronounced difference would be considered ample basis for generic separation, but until species of *Amplexus* can be reviewed a new genus should not be erected for this one species.

Amplexus rockfordensis Miller and Gurley

Plate 12, figures 4-8; Plate 17, figure 15

Zaphrentis Ida Winchell, 1865, [in part], Philadelphia Acad. Nat. Sci., Proc., p. 111.

Amplexus (?) *rockfordensis* Miller and Gurley, 1897, Illinois State Mus. Nat. History Bull. 12, p. 53, pl. 3, figs. 22, 23.

Amplexus? rockfordensis, 1899, Kindle, Bull. Am. Paleontology, vol. 3, bull. 12, p. 162.

Externals.—Large, curved ceratoid to nearly cylindrical; epitheca thin with broad spines hollow at their bases and of unknown length, striae, rugae, interseptal ridges; axial increase, geniculation observed; one specimen 28 mm in maximum diameter, 90 mm along convex side (incomplete); another specimen with small shallow cardinal fossula.

Transverse sections.—At diameter of 24 mm (very late ephebic stage of a cylindrical specimen), 29 major septa extending 1/4 of radius; minor septa existing as spines, largely restricted to counter quadrants; counter septum half again as long as other majors.

At diameter of 22 mm in ceratoid specimen (late ephebic stage), 36 major septa,

minors indicated at only one or two places. Septa in cardinal quadrants slightly thicker than in counter quadrants.

At diameter of 12 mm in same specimen (early ephebic stage), 30 major septa, those in cardinal quadrants thickened; those in counter quadrants long, thin, bending toward counter septum, tips partly fused; cardinal septum shortest.

Still earlier (late neanic) stage of same specimen (diameters 6.1 by 8.7mm), 25 majors, eleven cardinals quite thick, fused at tips; cardinal septum thickest, two or three septa near it fuse to first lateral septum; counters unfused, counter septum slightly longer than others.

In earlier neanic stage (diameters 4.1 by 5.3 mm), 14 septa, all thick; tabulae present.

Longitudinal sections.—Tabulae in cylindrical specimen mentioned above 6 or 7 mm distant, generally flat with sharply depressed borders, very slightly concave centrally.

Tabulae 1.5 to 6 mm distant in another specimen, sloping irregularly because of two geniculations in only 2 or 3 cm.

Occurrence.—Localities 12, 23.

Material.—Specimens studied, 9. Holotype, University of Chicago No. 6338; studied topotypes, University of Michigan Nos. 23133, 23233, 23234, 23235, 23236; other specimen, Illinois State Geological Survey No. 3498; possible representative, University of Missouri not numbered.

Remarks.—This species, although very closely related to *A. corniculum,* can be distinguished by its very much larger size, nearly flat tabulae, and the absence of prominent swellings at geniculations. It might have developed from *A. corniculum* which is similar in having a long counter septum, the ends of some counter septa fused in late stages, and a noticeable cardinal fossula.

Amplexus yandelli? (Keyes, 1894, p. 108, pl. 13, fig. 2) may be *A. rockfordensis,* but this cannot be checked.

Family Caniniidae

Genus Caninia Michelin in Gervais, 1840

"*Corallum* simple, turbinate and conical, often slender and cylindrical for a great part of its length.

"*Major septa* well developed and meeting in the center in the lower conical part of the coral, but in the cylindrical portions usually becoming amplexoid in character.

"*Minor septa* of various lengths in different species.

"*Cardinal fossula* variable in extent, characteristically limited by tabulae only, at the inner end, and with the flanking septa loose or disconnected.

"*Tabulae* well developed, but variable in regularity; they may be highly arched and vesicular. A marginal ring of more or less vertical *dissepiments,* usually thin and delicate, intervenes in the mature stages of growth between the tabulae and the wall." (Carruthers, 1908, p. 158.)

Genotype.—*Caninia cornucopiae* Michelin in Gervais, 1840.

Occurrence.—Widespread in the Carboniferous.

Remarks.—The taxonomic status of American corals referable to *Caninia* has been discussed in detail by the writer (Easton, 1944).

Caninia corniculum (Miller) emend. Easton

Plate 12, figures 1-3; Plate 16, figures 40-42

Amplexus corniculum Miller, 1891, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 9, pl. 1, figs. 21, 22. Adv. Sheets.

Amplexus blairi Miller, 1891, idem, p. 8, pl. 1, fig. 7.

Amplexus corniculum, Miller, 1892, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 619, pl. 1, figs. 21, 22.

Amplexus blairi, Miller, 1892, idem, p. 618, pl. 1, fig. 7.

?*Amplexus blairi,* Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 108.

Amplexus blairi, Keyes and Rowley, 1897, Proc. Iowa Acad. Sci. vol. 4, p. 29.

Amplexus blairi, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. ?67, 93, 96, 97, ?158, 164, ?177.

?*Amplexus* sp. cf. *A. blairi,* Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, p. 223.

Amplexus corniculus, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. ?67, ?93, 97.

Externals.—Curved ceratoid to cylindrical, generally with irregularly recurring swollen regions; commonly geniculate at swollen region; epitheca with concentric striae and stronger wrinkles, without interseptal ridges; calyx deep in holotype, 26 major septa extending about 2/3 of radius; cardinal septum very short, located in very deep fossula; counter septum slightly longer than neighboring majors; alar septa intermediate in length; minor septa rudimentary,

generally absent; calical floor nearly flat or steeply tilted cardinally.

Transverse sections. — In late ephebic stage (pl. 12, fig. 2) (diameters 9.0 by 9.3 mm), 28 major septa; single septum on either side of counter short, bent sharply toward counter septum; septa of both counter quadrants directed somewhat toward counter septum, thicker than septa of cardinal quadrants; septa thick, wavy; two or three tabulae cut centrally.

Another ephebic section (pl. 12, fig. 1) (diameters 9.7 by 10.0 mm), with 29 majors extend about ¾ of radius; fossula deep; counter septa terminating at edge of a transected tabula; secondary septa (spines) present between primaries, rejuvenescence suggested by outside ring of septal spines; septa of counter quadrants thicker than septa of cardinal quadrants.

In an earlier ephebic stage (diameter 7.1 mm), 27 major septa almost reaching center; cardinal fossula prominent; cardinal and counter quadrant septa about equally thickened, all tend to fuse at tips.

Largest observed specimen (diameters 19 by 17 mm), with 36 major septa extending ½ of radius; tabulae nearly flat except where abruptly turned down at cardinal fossula.

Broken calyx of holotype (diameters 9.3 by 10.0 mm) with 26 major septa, including recognizable alars; tips of septa near counter position fused; fusion in other specimens extensive, persisting distally beyond last tabulae.

Longitudinal-section.—Tabulae arched up steeply from counter position, then drop sharply from about tips of counter septa into cardinal fossula; about 4 tabulae in 5 mm.

Another specimen with 9 or 10 tabulae in 10 mm.

Occurrence.—Localities 1, 2, 8, 9, 48-52, 58, 66, ?69, ?76, 84. Keyes' reporting of it from the Burlington is probably erroneous.

Material.—Specimens studied, 105. Holotype, University of Cincinnati No. 2238; paratypes, University of Cincinnati No. 2238a; figured cotype of *A. blairi* Miller, University of Cincinnati No. 3918; other cotype of *A. blairi,* University of Cincinnati No. 3919; former cotype of *Z. chouteauensis* Miller, University of Cincinnati No. 24316; other specimens, some studied, University of Missouri Nos. 363, 364, 1043, 1045, 1132, 1191, not numbered, University of Cincinnati Nos. 24402 (as paratype of *Z. tenella*), 24403 (as cotype of *Z. tantilla*).

The specimen here taken as holotype is so listed in the University of Cincinnati collection, although Miller did not publish his designation. One of the original paratypes (University of Cincinnati No. 24406) is probably a *Cyathaxonia.*

Remarks.—External appearances suggest that several distinct types can be recognized, but the internal structure of the specimens examined by the writer is very stable. Miller's description of *A. blairi* and *A. corniculum* are not accurate, and these species were probably differentiated mainly on external appearances. The writer believes that the specimen of *A. blairi* figured by Miller is a cylindrical phase of this variable species. The specimen is incomplete, largely embedded in matrix, and badly flaked off, and is certainly not a fitting type. The other types of *A. blairi* are a much weathered fragment and a piece of coral largely dissolved by acid.

The writer has selected the specimen figured by Miller (1892, pl. 1, figs. 21, 22) as the holotype of *C. corniculum.* It is listed as the holotype in the catalogue of the University of Cincinnati, but was not officially so named by Miller in his work. The types of *A. blairi* Miller would be the types of the revised species if the writer followed Recommendation C of Article 28 of the "International Rules of Zoological Nomenclature," but clarity and stability are better achieved by choosing a specimen of the other species.

Keyes figured a specimen (1894, pl. 13, fig. 1) which is not conspecific with *A. blairi* Miller because it has much wider spacing of the tabulae.

C. corniculum may have had an early ephebic stage of long duration, because there are incomplete cylindrical specimens up to 15 mm in length with about 20 septa grouped in three bunches with three thick extensions meeting axially. Other individuals, however, certainly did not have this enduring phase.

The writer believes that the variable external forms recognized in this species relate to variable ecologic conditions. The *blairi* phase seems most common in impure lime-

stones and the *corniculum* phase seems most common in pure limestones.

This species can be recognized by the periodically and irregularly swollen "nodes," by the generally oblique tabulae, and by the small size.

C. corniculum resembles *C. cornucopiae* in size, shape, presence of dissepiments only in late ephebic stages, characteristics of cardinal fossula, lanceolate septa, long counter septum, down-turned tabular margins, and retreat of septa in late stages. It differs in having slightly depressed axial portions of tabulae, septa of counter quadrants sometimes thickest, and in having septa meeting axially only in very early stages.

Many specimens of *C. corniculum* do not have dissepiments, in which case they are apt to be confused with *Amplexus*.

Family Clisiophyllidae Nicholson and Thomson, 1883

Genus Koninckophyllum Thomson and Nicholson, 1876

"Simple or dendroid Rugose corals with clisiophylloid septa and fossula; the major septa are withdrawn from the axis except along the surface of the tabulae, the minor septa long; the tabulae are tent-shaped, and dissepiments fine and concentrically arranged; a styliform columella is present. Diphymorphs may occur." (Hill, 1939, p. 86.)

Genotype. — *Koninckophyllum magnificum* Thomson and Nicholson, 1883.

Occurrence.—Lower Carboniferous (typically Tournaisian) of British Isles, Belgium, Russia, China, Canada, United States.

Remarks.—For a review of the systematic position of the genus and a discussion of its relationships and occurrence, see Hill (1939, pp. 85-89). The writer agrees with her that *Koninckophyllum* is a recognizable genus. Hill (1939, p. 85) considers *Axophyllum* Thomson, 1877, *Acrophyllum* Thomson, 1883, *Eostrotion* Vaughan, 1915, and possibly *Lophophylloides* Stuckenberg, 1904, to be junior synonyms of *Koninckophyllum*, but *Axophyllum* Milne-Edwards and Haime, 1851, and *Acrophyllum* Thomson and Nicholson, 1876, are believed to be distinct.

Koninckophyllum glabrum (Keyes)

Plate 7, figures 1-5; Plate 17, figure 10

Cyathophyllum glabrum Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 105, pl. 12, figs. 6a, b.

Cyathophyllum glabrum, Van Tuyl, 1925, Iowa Geol. Survey, vol. 30, p. 110.

Cyathophyllum glabrum, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 154, 195.

Externals.—Simple, sharply curved ceratoid, may be slightly flattened on convex side (right cardinal quadrant of one specimen); epitheca marked by encircling striae, rugae, very sharp constrictions at rejuvenescence; interseptal ridges faint but persistent; calicular boss prominent in young specimens.

Transverse sections.—At late ephebic stage (diameters 24 by 26 mm), 80 septa, half about one-third as long as long majors; majors extend about one-half of radius; cardinal fossula small, deep, with three or four reflexed tabulae; cardinal septum about half as long as lateral majors; dissepimentarium half as long as majors, with about 4 ranges of concentric dissepiments; pseudo-lonsdaleoid dissepiments may exist because of transection of two or more stages of rejuvenescence.

At early ephebic stage (diameters 14 by 15 mm), about 34 majors, minors absent except for few septal spines; longest (cardinal) septa about 5.5 mm, tending to join tips in groups; cardinal septa somewhat pinnate, counters nearly parallel with counter septum; tabulae border median plate connected to it at counter end; median plate axial, about 3.7 mm long, not connected with septa; dissepiments few, mostly near cardinal fossula in about 3 ranges.

In late neanic stage (diameters 13.1 by 13.3 mm) most major septa join thick median plate; short secondary septa present; dissepiments sparse; tabular intersections frequent; median plate connected most strongly to counter septum.

In middle neanic stage (diameters 7.3 by about 7.0 mm) 26 major septa, mostly joined to thick median plate; secondary septa rudimentary; dissepiments very sparse.

Longitudinal section.—Dissepimentarium narrow, dissepiments nearly vertical, very elongate; tabulae swing distally with increasing rapidity toward axis, joined at median plate; small tabellae axial at greatest curvature of tabulae; tabular density about 15 in 1 cm.

Occurrence.—Localities 24, 25, 63, 80, 81.

Material.—Specimens studied, 3. The holotype may be in the Missouri Geological

Survey collection but it is not available and perhaps is lost. Specimens examined, University of Missouri No. 7209, not numbered.

Remarks.—The fossula is indistinct in most sections, but is recognizable. Interesting features in the coral are the rather coarse thick dissepiments and the progressive weakening and ultimate disappearance of the axial structure. The species seems closely related to *Koninckophyllum tortuosum* (Michelin) from the Tournaisian.

Genus Vesiculophyllum Easton n. gen.

Diagnosis.—Simple, straight to curved, nearly cylindrical, rugose corals; dissepimentarium very broad in mature specimens, consisting of large dissepiments elongate parallel to periphery, possibly formed only in late stages; septa sinuous, dilated; no axial column; tabulae numerous, generally incomplete, fine, gently sloping in outer regions, steeply sloping axially, all sloping proximally; septa not reaching axis or periphery if dissepiments be present.

Genotype. — *Vesiculophyllum sedaliense* (White), 1880.

Occurrence.—Known only from Chouteau limestone of Illinois and Missouri.

Remarks. — This genus differs from *Aphrophyllum* Dun and Benson, 1920, with which it is most closely allied, chiefly in having the tabulae concave upward and in having dissepiments between septa only in very late stage. It resembles *Dibunophyllum* in having closely packed tabulae at the axial ends of septa, but in the latter genus these are part of a spiderweblike axial structure consisting of tabellae and septal lamellae, whereas in *Vesiculophyllum* they are tabulae only. Septal lamellae and tabellae are not known in *Vesiculophyllum,* nor have naic septa been observed.

Aphrophyllum resembles this genus in the relative lengths of long and short major septa, in the obscure cardinal fossula, in the wide similarly formed dissepimentarium, in the dilated septa, and in lateral compression.

Vesiculophyllum sedaliense (White)

Plate 5, figures 5-9; Plate 17, figure 12

Chonophyllum sedaliense White, 1880, Contr. Invetrebrate Paleontology, No. 8 p. 157, pl. 39, fig. 3a. Extract from U.S. Geol. Survey, Twelfth Ann. Rept., (1878).

Chonophyllum sedaliense, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 116, pl. 14, fig. 9.

?Cyathophyllum glabrum, Sardeson, 1902, Am. Geol., vol. 30, no. 5, p. 306.

Chonophyllum sedaliense, Moore, 1927 Am. Assoc. Petrol. Geol. Bull., vol. 11, no. 2, p. 1330.

Chonophyllum sedaliense, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 128, 154, 195.

Externals.—Large, slender to thick; epitheca and dissepimentarium commonly not preserved in mature regions, leaving very irregular surface with edges of septa and tabulae showing; calyx very deep, nearly vertically walled distally; cardinal fossula prominent to obscure; septa in quadripartite arrangement, pinnate in cardinal quadrants.

Transverse sections.—In very late ephebic stage (diameters about 32 mm by 35 mm reconstructed), dissepimentarium occupies half of radius; dissepiments compressed, very elongate parallel to periphery; corallite compressed; major septa thick, sinuous; minor septa very short, separated from neighboring majors by concentric dissepiments.

In middle ephebic stage (diameters 15.2 by 18.0 mm incomplete), dissepimentarium (when present) occupies ¼ of radius; some major septa in part especially thickened, all long; minor septa short; dissepiments very sparse between major and minor septa; tabular intersections abundant between septa and in axial region; corallite compressed in cardinal-counter plane.

In early ephebic stage (diameters 9.8 by 10.3 mm), dissepimentarium absent; major septa long, thickened; cardinal and counter septa longest; tabular intersections abundant between septa, somewhat concentric in axial region.

In late neanic stage (diameters 6.7 mm by 6.9 mm), cardinal septum very long, swollen at axial end; counter septum somewhat longer than neighbors, very thick; septa pinnate in cardinal and counter quadrants, short; tabular intersections concentric in axial region.

In very early neanic stage (diameters 2.0 by 3.1 mm), cardinal septum a short spine, others not definitely determinable; tabulae occupy almost all of thecarium; section quadrilateral with four proto-septa presumably occupying corners, as cardinal septum certainly occupies one corner.

Longitudinal section.—Tabulae rather flat in peripheral area, sloping steeply toward apical end in axial area, produced upward, obliquely outward short distance

beyond septa; tabulae appear very incomplete because of intersections of sinuous septa.

Occurrence.—Localities 1, 8, 9, 23, 55-57.

Material.—Specimens studied, 33. Holotype, supposedly in Broadhead's collection, probably was destroyed by fire. Specimens examined, Illinois State Geological Survey Nos. 3503, 3504, 3505, 3506, University of Missouri Nos. 380, 1134, University of Chicago Nos. 1243, 2037, 21295, 31587, 31594.

Family LITHOSTROTIONTIDAE (Grabau 1927) Chi, 1931

Remarks.—The family Lithostrotiontidae, proposed by Grabau in 1927 in an unpublished syllabus used by students in the National University of Peking, was first published by Chi in 1931.

Genus LITHOSTROTION Fleming, 1828

Phaceloid and ceroid Rugose corals, which have typically a columella, long major septa, and large conical tabulae, usually supplemented by outer smaller and nearly horizontal tabulae. Dissepiments are well developed in the larger species, but absent in the very small forms. Increase is nonparricidal. (Hill, 1940, p. 166.)

Genotype.—*Lithostrotion striatum* Fleming, 1828.

Occurrence. — Lower Carboniferous through Lower Permian in Europe, Asia, northern Africa, North America, and Australia.

Remarks.—The genotype was established by the International Commission of Zoological Nomenclature in Opinion 117. For a review of the effects of this opinion, see Hill (1940, pp. 166, 167).

A large number of genera and subgenera have been erected upon variations from typical *Lithostrotion,* but these subdivisions have not all achieved ready acceptance. In the case of *Lithostrotion microstylum* White, the broad diagnosis of *Lithostrotion* applies, but the species differs from *Lithostrotion* in characters at least of equivalent value to those used by some authors to name new genera. It resembles *Cystophorastraea* Dobrolyubova, 1935, in being partly cerioid and partly aphroid, as well as in general morphologic relationships of septa and columella, but *L. microstylum* is not known to have a thamnastreoid phase.

The recognition of a very early Mississippian *Lithostrotion,* further contradicts the belief in America that the genus is an index of St. Louis and Ste. Genevieve ages; it has been reported from rocks of possible Pennsylvanian age in Canada. The general range of the genus abroad is very long, extending through rocks equivalent to our Lower Mississippian into rocks equivalent to part of our Lower Permian. It may be expected, therefore, that the range in America will be further extended.

LITHOSTROTION MICROSTYLUM White

Plate 13, figures 1-3; Plate 17, figure 1

Lithostrotion microstylum White, 1880, U. S. Geol. and Geog. Surveys Terr. 12th Ann. Rept., pt. 1, Contr. Invertebrate Paleontology no. 8, p. 159, pl. 40, fig. 7a, advance printing.

Lithostrotion microstylum, White, 1883, idem, p. 159, pl. 40, fig. 7a.

Lithostrotion microstylum, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 124.

non *Lithostrotionella hemisphaerica* Hayasaka, 1936, Mem. Fac. Sci. Agr., Taihoku Imp. Univ., vol. 13, no. 5, p. 61.

Externals.—Massive, somewhat flattened coralla; calyces irregularly polygonal, about 1 cm across, shallow, with pronounced central boss and surrounding raised ring formed by elongation of septa; examples of rapidly growing corallites overlapping neighbors common. Corallites branching, nearly recumbent on base, upturned at margin of coralla; holotheca not observed. Dimensions of topotype, 3 cm by 9 cm by 11 cm.

Transverse sections.—In mature region, corallites plocoid, aphroid; lonsdaleoid retreat of septa variable; dissepiments irregular, generally large; septa strong, 18 reaching columella becoming very thin near tips, 18 not quite reaching it at diameter of 8 mm; columella circular, strong, with faint radiating lines indicating incorporated tabellae or septa; traces of tabulae well shown, extending almost to tips of short septa.

Longitudinal section.—Columella free, solid rod with some vertical traces of tabellae or septa; dissepiments irregular, ovoid to commonly elongate parallel-bordered vesicles two or three times as long as thick, abruptly tapered at ends, sloping downward axially at angle of about 45°, meeting at border of corallites without intervening epitheca; where sections leave axial plane, septa and dissepiments form more or less un-

differentiated reticulate structure; some tabulae may have been misinterpreted as dissepiments, as typical tabulae were not recognized.

Occurrence.—Localities 1, 9.

Material.—Specimens studied, 2. Holotype was probably lost in the fire which destroyed the Broadhead collection. Studied topotypes, University of Missouri No. 1357, University of Chicago No. 1265. A specimen is listed in the collection of the Indiana State Museum from the "Chouteau group, Sedalia, Mo."

Remarks.—The specimen in the Indiana State Museum may be the holotype. The specimens examined by the writer are within the size range (10-12 cm) given for the holotype, but are probably better preserved.

Keyes' statement (Keyes, 1894, p. 124) that there is "some doubt as to the locality" is puzzling in view of a clear statement by White as to where Broadhead collected the specimen; since that time at least two and possibly three more specimens have been collected.

Family FAVOSITIDAE Milne-Edwards and Haime

Genus FAVOSITES Lamarck, 1816, emend. Smith and Gullick, 1927

Tabulate coral. Corallum compound. Corallites contiguous and prismatic. Walls perforated by pores. Septa absent or merely represented by rows of spine-like processes. Tabulae complete and more or less horizontal. (Smith and Gullick, 1927, p. 117.)

Genotype.—*Favosites gothlandicus* Lamarck, 1816.

Occurrence.—Silurian and Devonian of many parts of the world; rarely Lower Mississippian of America.

Remarks.—Lang, Smith, and Thomas (1940, p. 94) definitely consider *Palaeofavosites* Twenhofel, 1914, to be a junior subjective synonym of *Favosites*. They apparently believe that *Calamopora* Goldfuss, 1829, is a junior subjective synonym (idem, p. 29) and state (idem, p. 28) that *Boreaster* Lambe, 1906, is a possible synonym.

FAVOSITES DIVERGENS White and Whitfield

Plate 13, figure 4; Plate 17, figure 3

Favosites, White and Whitfield, 1862, Boston Soc. Nat. History Proc., vol. 8, p. 306.

Favosites divergens Winchell, 1865, Acad. Nat. Sci. Philadelphia Proc., p. 112.

Favosites Whitfieldi White, 1874, Prelim. Rept. Invertebrate Fossils, p. 15. From U. S. Geog. Geol. Survey W. 100th. Mer.

Favosites divergens, White, 1877, U. S. Geog. Survey W. 100th Mer. Rept., vol. 4, p. 79.

Externals.—Corallum of holotype about one-half of hemisphere, corallites diverging rapidly near base, prostrate and budding rapidly in the center of mass; corallites irregularly polygonal, about 2.0 to 3.5 mm in diameter; calyces deep.

Transverse section.—Walls with thin median line at plane of junction; very few mural pores observed.

Longitudinal section. — Walls slightly wavy; tabulae complete, strong, generally convex, some flat or concave, sometimes oblique, about 8 in 10 mm.

Occurrence.—The bed from which the holotype was collected was not specified by the authors and the label has only the notation "Kinderhook group, Burlington, Iowa." Coarsely crystalline weathered limestone adhering to the specimen, however, suggests that it came from the Chouteau limestone. White's specimen is from the lower Carboniferous at Ewells Spring, Arizona (horizon unknown).

Material.—Specimens studied, 1. Holotype and only known specimen from type locality, American Museum of Natural History No. 6363/1; specimen mentioned by White, not seen by the writer, United States National Museum No. 8536.

Remarks.—The occasional oblique tabulae are unusual in *Favosites* but they are not sufficiently steeply tilted to be typical of the mural vesicles characteristic of *Pleurodictyum*.

FAVOSITES? MANCUS Winchell

Plate 13, figure 6

Favosites? mancus Winchell, 1865, Acad. Nat. Sci. Philadelphia Proc., p. 112.

Favosites? mancus White, 1877, U. S. Geog. Survey W. 100th Mer. Rept., vol. 4, p. 79.

Externals.—Corallum very small, about 6 mm in diameter (reconstructed), hemispherical; corallites polygonal, very small, about 1 mm in diameter, prostrate around edges of corallum; walls relatively thick; basal epitheca thin, possibly wrinkled.

Longitudinal section.—Walls increasing rapidly in thickness away from basal epi-

theca; tabulae thin; mural pores indefinitely determined.

Occurrence.—Locality 12.

Material.—Specimens studied, 1. Holotype and only known specimen, University of Michigan No. 23132.

Remarks.—This specimen may represent a very young corallum of *F. divergens* White and Whitfield, but this possibility cannot be tested without study of additional specimens. A label accompanying the specimen indicates that Girty studied and intended to figure it; however, his findings have not been published and it is not known how he regarded the species. Possibly Girty prepared the polished section figured here.

Winchell, who did not observe the tabulae, thought the species might be referable to *Conopoterium,* but the regularly disposed corallites are not typical of that genus.

The specimen is so small that sufficient details cannot be observed to warrant referring it to any genus with certainty, therefore the writer questionably retains it in its original genus, although it might be referred to *Pleurodictyum.*

Genus Pleurodictyum Goldfuss, 1829

Genotype. — *Pleurodictyum problematicum* Goldfuss, 1829.

Remarks.—Students are not in agreement as to the proper disposition of *Pleurodictyum* and *Michelinia,* but the writer concurs (Easton, 1943, p. 136) with Lang, Smith, and Thomas (1940, p. 103) that *Michelinia* is a junior subjective synonym of *Pleurodictyum.* Writers who separate these genera consider *Pleurodictyum* to be characterized by discoidal or appressed coralla with polygonal or subcylindrical corallites radiating from the center of the base and to have the tabulae not markedly arched, septa represented by rows of spines, and irregularly perforate walls. In contrast they consider *Michelinia* to have larger noticeably angular corallites radiating upward and outward to form rather large coralla with vesicular tabulae.

Pleurodictyum expansum (White)

Plate 13, figure 9; Plate 17, figure 2

Michilinia expansa White, 1880, U. S. Geol. and Geog. Surveys Terr. 12th Ann. Rept., pt. 1; Contr. Invertebrate Paleontology, no. 8, p. 158, pl. 39, figs. 2a, b. Advance printing.

Michilinia expansa, White, 1883, idem.

Leptopora typa, Weller, 1898, [in part], U. S. Geol. Survey Bull, 153, p. 323.

Leptopora expansa, Robinson, 1917, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 164.

Externals.—Corallum conical, gently convex on top; corallites five or six-sided, angles rounded; calyces very deep, walls vesicular, steep, floor vesicular, tending to be flat; epitheca not preserved.

Longitudinal section.—Walls very thick, lined with one or two ranges of large vesicles standing nearly vertical; tabulae almost always concave, complete, about 8 in 1 cm.

Dimensions.—Corallum 2.5 cm high, 5 cm by 4 cm across surface; corallites about 7 mm in diameter, 4 or 5 mm deep.

Occurrence.—Locality 9.

Material.—Specimens studied, 1. Holotype and only known specimen, University of Chicago No. 6687.

Remarks.—Pronounced Liesegang rings in the walls of the single available specimen, combined with a vugular condition of the vesicles prevent exact determination of the structure, but the species seems distinct from other American representatives of *Pleurodictyum.* The original description mentions more than one specimen and although the one figured was not designated the holotype by White, it is so recorded in the Walker Museum catalogue.

Appendix to the Favositidae

Remarks.—*Palaeacis* has been transferred back and forth between the corals and sponges but the genus is now thought to be a possible ally of the Favositidae. Hinde (1896, p. 447) considered it to represent a new family which he did not name. The writer feels that a new family should not be established until a general revision is made.

Genus Palaeacis Haime in Milne-Edwards, 1857

Paloeacis Haime, in Milne-Edwards, 1857, Histoire naturelle des coralliaires ou polpyes proprement dits, Atlas, Expl. pl. E-1.

Palaeacis Haime, in Milne-Edwards, 1860, idem, vol. 3, p. 171.

Sphenopoterium Meek and Worthen, 1860, Acad. Nat. Sci. Philadelphia Proc., p. 447.

Ptychochartocyathus Ludwig, 1866, Paleontographica, vol. 14, pt. 5, p. 189.

Palaeacis, Seebach, 1866, Nachr. Gesellsch. Wissensch. zu Göttingen, p. 241.

Palaeacis, Seebach, 1866, Zeitschr. deutsch. geol. Gesellsch., vol. 18, p. 308.

Palaeacis, Kunth, 1869, idem, vol. 21, pp. 186, 187.

Palaeacis, Koninck, 1872, Nouvelles Recherches sur les Animaux Fossiles du Terrain Carbonifère de la Belgique, pt. 1, p. 154.

Palaeacis, Etheridge and Nicholson, 1878, Annals and Mag. Nat. History, ser 5, vol. 1, p. 212.

Palaeacis, Hinde, 1896, Geol. Soc. London Quart. Jour., vol. 52, pt. 3, pp. 443-447.

Palaeacis, Robinson, 1917, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 165.

Diagnosis.—Small, simple to compound corals, calyces shallow, evenly concave, smooth, surface finely reticulate, perforate; septa present in calyces as fine striae; internal structure reticulate, of anastomosing tubes and vesicles.

Genotype.—Palaeacis cuneiformis Haime in Milne-Edwards, 1857.

Occurrence. — Lower Mississippian of United States; Lower Carboniferous (Upper Viséan) of Australia; Lower Carboniferous of British Isles.

Remarks.—Palaeacis is distinguished from *Microcyathus* chiefly by means of internal structure. The two genera are essentially identical externally, except for the shape of calyces and the mode of attachment of coralla. This genus was first spelled *Paloeacis,* an evident misprint which Haime subsequently corrected.

Sphenopoterium Meek and Worthen, 1860, has been recognized as a junior synonym of *Palaeacis* since 1866. It was founded upon *S. obtusum* Meek and Worthen from Keokuk beds near Nauvoo, Illinois.

Conopoterium Winchell, 1865, was founded upon *C. effusum* Winchell. Etheridge and Nicholson (1878, p. 217) believed this genus to be a relative of *Palaeacis* but a study of the types of *C. effusum* shows that it is quite unlike *Palaeacis,* being more closely allied to typical *Favositidae. Conopterium* (Keyes, 1894, p. 118 and Weller, 1898, p. 189) is a misspelling.

Ptychochartocyathus Ludwig, 1866, is a junior synonym of *Palaeacis,* but is rarely found in the literature because most authors have ignored Ludwig's genera. Lang and Smith have applied to the International Commission on Zoological Nomenclature for suppression of all Ludwig's genera on the grounds of unnecessary complexity and faulty foundation. The decision is pending.

For a review of the early opinions regarding *Palaeacis,* its synonyms, and its relationships, see Etheridge and Nicholson (1878). They considered only three species to be available and believed *P. enorme* to be a junior synonym of *P. cyclostoma* (Phillips). Lack of comparative material prevents the writer from attempting to evaluate their conclusions and he prefers to recognize species of *Palaeacis* on the basis of symmetry, shape, and number of corallites.

Palaeacis enormis var. *depressus* Meek and Worthen is erroneously listed from the Rockford limestone in Indiana by Etheridge and Nicholson (1878, p. 225). This variety is known only from the Fern Glen formation of Illinois. It and the two preceding species are actually referable to *Microcyathus.*

PALAEACIS CONICA Easton, n. sp.

Plate 16, figure 19

Zaphrentis tantilla Miller, 1891, [in part], Indiana Dept. Geol. Nat. Res., 17th Ann. Rept., p. 11. Adv. Sheets.

Zaphrentis tantilla, Miller, 1892, [in part], Indiana Dept. Geol. Nat. Res., 17th Ann. Rept., pp. 621, 622.

Description.—Corallum ceratoid, elliptical in cross-section, very slightly curved; exterior covered with fine anastomosing furrows; small secondary corralite extends short distance from primary calyx; calyx moderately deep, evenly concave, without evidence of calical structures. Height 12.0 mm, greatest diameter 4.2 mm, least diameter in same plane 3.8 mm.

Comparison.—This species differs from *P. bifidus* Weller from the Fern Glen formation in being curved ceratoid, not extremely flattened, and in having only one small subordinate offset.

Occurrence.—Localities 7, 8.

Material.—Specimens studied, 2. Holotype, University of Cincinnati No. 24310; possible representative, University of Chicago No. 9767.

Remarks.—The holotype was formerly one of the cotypes of *Z. tantilla* Miller and as such was only partially freed of its matrix. It is so very different from other described *Palaeacis* that it warrants separate recognition.

Family Cleistoporidae Easton, n. fam.

Diagnosis.—Compound coralla, typically flat, spreading or discoid; corallites polygonal; calyces inverted, without prominent calical structures; septa indistinct; tabulae indistinct or merging with reticulate visceral tissue; tubular visceral spaces partitioned by diaphragms; peritheca with or without scales.

Type genus. — *Cleistopora* Nicholson, 1888.

Remarks.—Miller (1892, p. 616) suggested that if *Leptopora* Winchell, 1863, should stand alone, it would be referable to the family Leptoporidae (for which a diagnosis was only incidentally given) and it would obviously be the type genus of the family. *Leptopora Winchell,* 1863, however, is a junior homonym of *Leptopora* d'Orbigny, 1849, a Cretaceous bryozoan. Therefore a new name is necessary for this family to which *Leptopora* Winchell, 1863, *Squameophyllum* Smyth, 1933, *Ethmoplax* (=*Stratiphyllum*=*Stratophyllum*) Smyth, 1939, have been referred.

The Cleistoporidae are closely related to the Favositidae by reason of their compound nature, tabulate corallites, and perforate walls.

Genus Cleistopora Nicholson, 1888. emend. Easton

Non *Leptopora* d'Orbigny, 1849, Mag. Zoology Rev., no. 2, p. 504.

Leptopora Winchell, 1863, Acad. Nat. Sci., Philadelphia Proc., p. 2.

Cleistopora Nicholson, 1888, Geol. Mag., dec. 3, n. s., vol. 5, p. 150.

Leptopora, Robinson, 1917, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 163.

Squameophyllum Smyth, 1933, Royal Irish Acad. Proc., vol. 41, sect. B, p. 171.

Stratophyllum Smyth, 1933, idem, p. 173.

Ethmoplax Symth, 1939, Nature, London, vol. 143, p. 859.

Non *Stratiphyllum* Scheffen, 1933, Norske vidensk-akad. Oslo Skrift., p. 35.

Stratiphyllum Lang, Smith, and Thomas, 1940, Index of Paleozoic Corals, p. 124.

Emended diagnosis.—Coralla flat, discoid to elongate, possibly encrusting, with wrinkled epitheca; corallites polygonal to subrounded, rarely overlapping; calical floors flat, convex, or concave and conical; walls more or less persistent, generally traceable externally; septa nearly or entirely absent except as minute structures within walls; visceral cavity filled with reticulate tissue which may or may not contain transverse diaphragms, or filled with horizontal tabulae which may be granular on upper surfaces; walls perforate; epithecal scales may be present.

Genotype.—*Cleistopora geometrica* (Edwards and Haime), 1851.

Occurrence.—Genotype from Lower Devonian of Viré and Loué, Sarthe, France. Other species occur in the Tournaisian at Tournai, Belgium; Z_2 of Hook Head, Ireland; Chouteau limestone (unrestricted), McCraney limestone, and Prospect Hill sandstone of Mississippi valley, probably in Carboniferous of Utah.

Remarks.—*Leptopora* Winchell, 1863, has been commonly used interchangeably with *Cleistopora* Nicholson, 1888, in America, but insofar as is known to the writer, without published reasons. It is apparent, however, that close similarity of external form is the reason for confusion.

Lang, Smith, and Thomas (1940, p. 137) tentatively considered *Vaughania* Garwood, 1913, a synonym of *Leptopora* Winchell, although they did not state that the latter genus is a synonym of *Cleistopora* Nicholson. The original diagnosis of *Leptopora* suggests the characters of *Vaughania,* but this is because *Leptopora* was supposed to have "interior of cells filled with a finely vesicular tissue" (Winchell, 1863, p. 2), whereas these structures are, more accurately, reticulate.

Smyth (1933a, p. 171) considered *Squameophyllum spumans* Smyth and *Stratophyllum tenue* Smyth to be closely related, but transitional forms were not known and the differences between reticulate and tabulate visceral structure seemed to warrant placing the species in different genera. Specimens from the Chouteau limestone studied by the writer possess characters which link the two species and make the combining of the two genera advisable. This linkage is demonstrated ontogenetically in one specimen. In its earlier stages it resembles *Cleistopora* in having well-defined perforate walls and reticulate visceral tissue with diaphragms. In the latest stages the visceral cavity is entirely filled with tabulae whose upper surfaces are generally granular; however, the walls remain strong throughout, although they are less strong in the later

than in the earlier stages. Thus, with variations, the generic characters of *Squameophyllum, Ethmoplax,* and *Cleistopora* are all contained within this one specimen.

Squameophyllum is supposed to differ from *Cleistopora* chiefly in lacking diaphragms and in having sloping walls, rather than a convex floor in each corallite. Specimens of *Leptopora typa* Winchell seldom possess diaphragms, and aside from the corallites having convex floors, resemble *Squameophyllum spumans* very closely. Variation in this Chouteau species is extreme, and some sections show walls and visceral tissue merged so closely that they cannot be differentiated (like *Squameophyllum*), whereas other sections show marked differences between wall and visceral structure (like *Cleistopora*). Typically reticulate structure tends to be horizontal, sometimes markedly so, and therefore the recognition of *Ethmoplax* is even further to be questioned because of the similarity between its genotype and species of *Cleistopora* in the Chouteau.

The writer is unable to evaluate the taxonomic significance of epithecal scales. If they are accretionary phenomena, such as are known in *Xenophora,* they may very well be coincidental structures.

Because of the close similarity between *Cleistopora, Squameophyllum,* and *Ethmoplax,* the writer does not consider these genera to warrant separation, even though this group may have wide limits of individual variation. Some systematists may wish to preserve *Squameophyllum* and *Ethmoplax* as subgenera. Others may wish to consider *Cleistopora ramosa* (Rowley) described here as the type of a new genus of equal rank. In the opinion of the writer, this latter course would be inadvisable because of the demonstrable relationship.

The course followed by the writer establishes a long stratigraphic range for *Cleistopora,* but its species are certainly distinct enough to permit correlation.

Cleistopora procera (Rowley)

Plate 15, figure 5; plate 17, figures 8, 9

Leptopora procera Rowley, 1901, Am. Geologist, vol. 27, p. 349, pl. 28, fig. 37.

Leptopora procera, Robinson, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 164.

Description.—"The base of this coral differs but little from Leptopora placenta, being flattened and with large shallow cups and a very wrinkled and rugose epithecal under surface but in producing tall crowded stems above by calicular budding, it differs from all the species of Leptopora with which the author is acquainted. The stems spring from the shallow cups below, are more or less round, very rugose and distorted and, crowding together at the top, the otherwise round cups become polygonal. From the calyx of one of the stems three small stems arise. No septa are observable nor are placenta, but the latter are surely present. The cups are shallow and are pitted or cellular in appearance." (Rowley, 1901, pp. 349, 350.)

Occurrence.—Localities 28, 108.

Material.—The species apparently is based upon a single specimen in the Rowley collection which the writer understands is now unavailable for study. The plesiotype is University of Chicago No. 9765.

Remarks.—Until the type of this species can be studied, the internal structure must remain unknown. It is probable that the specimen illustrated on plate 17, figures 8 and 9, may be a young specimen of *C. procera.* The specimen is not as expanded vertically as the type appears to be, but the habit is otherwise quite similar. The internal structure is seemingly no different from that of *C. typa.*

Cleistopora ramosa (Rowley)

Plate 14, figures 4, 5; Plate 15, figure 6

Leptopora ramosa Rowley, 1901, Am. Geologist, vol. 17, p. 349, pl. 28, fig. 36.

Leptopora ramosa, Robinson, 1917, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 164.

Externals.—Corallum massive, cerioid, oblate, tending towards fasciculate in most advanced (gerontic?) stage; epitheca thin, with striae, well defined rugae; calyces not very deep, with broadly sloping vesicular walls. Length of plesiotype 9.5 cm; greatest breadth, 7.5 cm; mean breadth about 5 cm; thickness, 3.5 cm.

Transverse sections. — Corallites, polygonal, 5 to 7 sided, separated by dense crenulate walls, each about 0.3 mm thick, meeting at well-defined zigzag medial line; walls irregularly perforate; centers of corallites filled with dense sclerenchyme penetrated

by convoluted tubes commonly commencing at mural pores, following random paths not in one general plane, borders in early stages generally not vesicular, in middle adult stages borders may be vesicular on one or more sides, in late stages corallites entirely filled by vesicular matter without reticulate structure; vesicles elongate, approximately parallel with walls grading into reticulate structure; septal crests common.

Longitudinal sections. — Corallites increase regularly in diameter; walls vary rapidly in thickness; vesicles convex upward, sloping steeply downward at inner ends; inner reticulate zone diminishing upward, replaced entirely by vesicles; septal crests or traces common on vesicles; convoluted tubes in reticulate zone partitioned by diaphragms.

Comparison.—This spieces differs from other forms of *Cleistopora* by its more elongate colonies and its ontogenetic change from reticulate to vesicular structure.

Occurrence.—Locality 28.

Material.—Specimens studied, 1. Illinois State Geological Survey No. 3500; holotype, Rowley collection, not studied.

Remarks.—Although the structural development is much different from other species of *Cleistopora,* the writer prefers to consider it a specialized member of that genus. Its latest stages are very similar to the typical structure of *Pleurodictyum* and appear to illustrate the phylogeny of that genus, but its stratigraphic position shows that *C. ramosa* is not ancestral.

Cleistopora typa (Winchell) emend. Easton

Plate 14, figures 1, 2; Plate 16, figures 1-4

Leptopora typa Winchell, 1863, Acad. Nat. Sci., Philadelphia Proc., p. 3. [in part].

Leptopora typa, White, 1880, Contr. Invertebrate Paleontology no. 6, p. 122, pl. 34, figs. 12a, 12b.

Lepidopora typa, White, 1880, idem, no. 8, p. 159.

Michilinia? placenta White, 1880, idem, no. 8, p. 157, pl. 39, figs. 1a-d.

Michilinia placenta, White, 1880, idem. no. 8, p. 159.

Leptopora typa, White, 1883, U. S. Geol. and Geog. Survey Terr. 12th Ann. Rept., pt. I, p. 122, pl. 34, figs. 12a, b.

Leptopora gorbyi Miller, 1891, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 6, pl. I, figs. 1-4, Adv. Sheets.

Leptopora gorbyi, Miller, 1892, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., (1891), pp. 616-617, pl. I, figs. 1-4.

Leptopora typus, Miller, 1892, Indiana Dept. Geol. Nat. Res. 17th Ann. Rept., p. 617 (1891).

Cleistopora placenta, Keyes, 1894, Missouri Geol. Survey, vol. 4, pt. 1, p. 119, pl. XIV, fig. 11.

Cleistopora typa, Keyes, 1894, idem pp. 119, 120.

Cleistopora typa?, Keyes and Rowley, 1897, Iowa Acad. Sci. Proc., vol. 4, p. 30.

Leptopora typa, Weller, 1898, U. S. Geol. Survey Bull. 153, p. 323.

Leptopora typa, Weller, 1901, Trans. St. Louis Acad. Sci. vol. 11, pp. 194, 195, pl. 20, fig. 19.

Leptopora typa, Merrill, 1905, U. S. Nat. Mus. Bull. 53, pt. 1, p. 351.

Leptopora typa, Robinson, 1917, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 164.

Leptopora placenta, Robinson, 1917, idem, p. 164.

Leptopora gorbyi, Robinson, 1917, idem, p. 164.

Leptopora typa, Van Tuyl, 1925, Iowa Geol. Survey, vol. 30, pp. 58, 104, 105, pl. 3, fig. 1.

Leptopora typa, Moore, 1927, Am. Assoc. Petrol. Geol., Bull., vol. 11, no. 2, p. 1330.

Leptopora typa, Moore, 1928, Missouri Bur. Geol. Mines, ser. 2, vol. 21, pp. 63, 97, 154, 195.

Leptopora typa, Laudon, 1931, Iowa Geol. Survey, Ann. Rept. vol. 35, pp. 393, 426, 427, 429, (1929).

Externals.—Corallum thin, subcircular; corallites 5- or 6-sided, very shallow, slightly domed axially; floors granular; epitheca concentrically striate. Diameter of holotype about 4.5 cm; thickness about 3 mm; diameter of corallites about 6 mm.

Transverse section.—Walls strong, dense, line of contact between adjacent walls irregularly preserved; nearly straight pores in walls continue into reticulate structure; centers of corallites irregularly reticulate with occasional diaphragms crossing tubules.

Longitudinal section. — Epitheca thick with faint fibrous structure normal to plane of epitheca; walls merge with internal reticulate structure which tends toward horizontality; diaphragms infrequent, dominantly vertical.

Occurrence.—Localities 1, 2, 8, 16, 23, 26, 28, 30, 35, 38, 39, 44, 65, 78, 85.

Material.—Specimens studied, 39. Holotype, University of Michigan No. 14253; other specimens, University of Missouri Nos. 348, 1049, 1138, Illinois State Geological Survey Nos. 3499, 3507, University of Chicago No. 9764; Miller's figured specimens of *Leptopora gorbyi* are University of Cincinnati No. 3273, whereas the other

original cotypes are University of Cincinnati No. 24314.

Remarks.—This species has definite diaphragms, termed tabulae by Smyth. The writer prefers the word diaphragms because the structures occur within tubules rather than extend across the floors of the corallites, and they are commonly vertically arranged.

The species differs from *Squameophyllum spumans* Smith in having diaphragms, in possibly lacking scales, in being more discoid, and in having stronger walls.

The writer here designates the specimen mentioned by Winchell (1863, p. 3) having a diameter of 1.27 inches as the holotype of the species. It was not the principal specimen described by Winchell, but subsequent usage has made it a better type for this than the other two specimens.

Leptopora gorbyi Miller was proposed because Miller recognized that the original description of *L. typa* did not fit the common Chouteau species. The writer has studied Miller's types and finds them to be conspecific with *L. typa* as herein revised. Lang, Smith, and Thomas (1940, p. 76) err in stating that White (1883, pl. 34, figs. 12a, 12b) figured the genoholotype of *Leptopora.*

Cleistopora sp.

Plate 16, figure 5

Leptopora typa Winchell, 1863, [in part], Acad. Nat. Sci., Philadelphia Proc., p. 3.

Two of the cotypes of *Leptopora typa* differ from the selected holotype of that species in that the corallites are 3.5 to 4.0 mm in diameter with very definite but thin walls and with the floors of collarites proportionately more domed than in *C. typa.* The coralla are about 1.5 mm thick and one nearly complete specimen is 18 mm in diameter. The specimens seem to be quite similar to *Leptopora winchelli* White.

One of the specimens is a cast in vugular cherty sandstone and the other is a chalcedony replacement. Internal structure was not observed.

Occurrence.—Locality 27.

Material.—Specimens studied, 2. University of Michigan No. 2078.

Appendix to the Cleistoporidae

Genus Microcyathus Hinde, 1896

Microcyathus Hinde, 1896, Geol. Soc. London Quart. Jour., vol. 52, pt. 3, p. 447.

Microcyathus, Robinson, 1917, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 166.

Microcyathus, Williams, 1943, U. S. Geol. Survey, Prof. Paper 203, p. 59.

Diagnosis.—Coralla compound, attached to some foreign body; calyces open and nearly vertically walled, with septa possibly represented by rows of crowded tubercles or blunt spines; outer surface with discontinuous sinuous ridges and occasional apertures; solid calcareous tissue fills bottom and lines walls of calyces; openly porous reticulate tissue covers outer surface of coralla.

Genotype.—*Hydnopora? cyclostoma* Phillips.

Occurrence.—Lower Mississippian (Kinderhook) of United States; Lower Carboniferous (Viséan D_3) of England and Scotland.

Microcyathus enormis (Meek and Worthen)

Plate 16, figure 18

Sphenopoterium enorme Meek and Worthen, 1860, Acad. Nat. Sci. Philadelphia Proc., p. 448.

Sphenopoterium enorme, Meek and Worthen, 1861, Am. Jour. Sci., ser. 2, vol. 32, p. 169.

Sphenopoterium enorme, Meek and Worthen, 1861, idem, p. 175.

Sphenopoterium enorme, Meek and Worthen, 1866, Illinois Geol. Survey, vol. II, p. 146, pl. 14, figs. 1a, b.

Palaeacis cyclostoma, Etheridge and Nicholson, 1878, Annals Mag. Nat. History, ser. 5, vol. 1, p. 221.

Palaeacis enormis, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 118.

Palaeacis enormis, Keyes and Rowley, 1897, Iowa Acad. Sci. Proc., vol. 4, p. 29.

Palaeacis enormis, Weller, 1898, U. S. Geol. Survey, Bull. 153, p. 404.

Sphenopoterium enorme, Kindle, 1899, Bull. Am. Paleontology, vol. 3, bull. 12, pp. 140, 219.

Palaeacis enormis, Kindle, 1899, idem. p. 162.

Palaeacis enormis, Rowley, 1908, Missouri Bur. Geology Mines, 2nd ser. vol. 8, p. 64, pl. 16, figs. 22-28.

Microcyathus enormis, Robinson, 1917, Connecticut Acad. Arts Sci. Trans., vol. 21, p. 167.

Microcyathus enormis, Williams, 1943, U. S. Geol. Survey, Prof. Paper 203, p. 59, pl. 6, figs. 9-13.

Description.—"Corallum small, subglobose, obtusely subturbinate; rounded and apparently retaining some remains of a scar of attachment at the base. Cells four or more, rather irregularly disposed, circular, and moderately deep. Surface slightly more coarsely marked than the last [*Sphenopoterium compressum* Meek and Worthen] but otherwise similar.

"Height, 0.45 inch; transverse diameter about 0.43 inch; breadth of cells, about 0.18 inch." (Meek and Worthen, 1860, p. 448).

Occurrence.—Localities 12, 44, 82, 83.

Material.—Specimens studied, 2. Primary types from the Rockford limestone, University of Illinois No. 10858. Keyes' specimens may be lost, therefore his identification of the species from the Louisiana limestone can not be checked.

Family Syringoporidae Milne-Edwards and Haime

Genus Syringopora Goldfuss, 1826

Diagnosis.—Corallum fasciculate; corallites thin, connected by lateral tubes; septa very short or absent; tabulae steeply inclined proximally, inosculating to form inner wall.

Genotype.—*Syringopora ramulosa* Goldfuss, 1826.

Occurrence.—Widely distributed, Silurian through Carboniferous.

Remarks.—*Drymopora* Davis, 1887, is a subgenus of *Syringopora,* according to Bassler (1915, p. 463). Lang, Smith, and Thomas (1940, p. 137) point out that *Vaughanites* Paul, 1937, is a junior homonym, *Vaughanites* Woodring, 1928, having priority, and suggest that no new name be proposed for Paul's subgenus. They (idem, p. 65) consider *Harmodites* Fischer von Waldheim, 1828, to be an objective synonym of *Syringopora.*

Syringopora harveyi White

Plate 13, figures 7, 8

Syringopora Harveyi White, 1862, Boston Soc. Nat. Hist. Proc., vol. 9, p. 32.

?Syringopora Harveyi?, White, 1874, Prelim. Rept. Invertebrate Fossils, p. 17.

?Syringopora Harveyi?, White, 1877, U. S. Geog. Survey W. 100th Merid., vol. 4, p. 80.

?Syringopora harveyi?, Keyes, 1894, Missouri Geol. Survey, vol. 4, p. 141, pl. 14, fig. 6a.

Syringopora harveyi, Shepard, 1898, Missouri Geol. Survey, vol. 12, pt. 1, p. 122.

Syringopora harveyi, Moore, 1928, Missouri Bur. Geol. Mines, Ser. 2, vol. 21, pp. 97, ?128, ?154, 189, 195.

Externals. — Corallum small, corallites very thin, straight to slightly curved, about 1 to 1.5 mm in diameter, tending to be connected in threes at wide intervals; epitheca smooth to minutely striate.

Transverse section.—Septa about 20, extremely short, thin, not always distinguishable, may occur as septal crests on tabulae towards axis of corallite. Tabular intersections elongate oval, generally constricted across shortest axis.

Longitudinal section.—Tabulae dipping steeply toward axial tube, which is crossed by tabulae or diaphragms spaced more widely than outer tabulae.

Occurrence.—Localities 1, 2, 23, 55, 59, 63, 65, 74, 87. The original specimens were collected from the "Chemung beds, and the lower division of the Burlington limestone, Burlington, Iowa." The first of these can be interpreted as Kinderhook generally, but the second locality has no meaning.

Material.—Specimens studied, 4. Location of primary types unknown; plesiotypes, University of Missouri No. 2238, Illinois State Geological Survey No. 3508; other specimen (formerly cotype of *Z. tantilla*), University of Cincinnati No. 24315.

Remarks.—The species can be distinguished from some other members of the genus by its thin corallites, but the lack of published figures of internal structure in the genus makes synonymies uncertain. Species of *Syringopora* should be more adequately figured so that detailed comparisons can be made.

The specimen of *Syringopora* included in the cotypes of *Z. tantilla* was a fragment of the same shape and size as that species and the calyx was filled with limestone matrix. *Z. tantilla* is omitted from the synonymy of *S. harveyi* because its inclusion would be apt to be more confusing than clarifying.

Family Auloporidae Nicholson, 1879

Genus Aulopora Goldfuss, 1829

Compound corals composed of creeping tubes connected by their entire lower surfaces to shells or other foreign bodies. Colony multiplies by tubes budding frm below calyx mouth; tubes seldom in contact except at point of attachment to parent.

Mural pores may be present where tubes are in contact, but generally occur only where buds are given off. Septa rudimentary, represented by vertical ridges. Scattered tabulae in some species. (Stewart, 1938, p. 78.)

Genotype.—*Aulopora serpens* Goldfuss, 1829.

Occurrence.—Widely distributed, Ordovician to Carboniferous.

Aulopora? sp.

Plate 17, figure 11

Occurrence.—Locality 8.

Material.—Specimens studied, 1. University of Chicago No. 47246.

Remarks.—One specimen with curved, evenly expanding, prostrate corallites connected by thin tubes (stolonal budding) near their bases was observed. The exteriors are smooth and the corallites all face in the same direction. The colony is not attached.

Genus Cladochonus McCoy, 1847

Diagnosis.—Corallum compound, with a reptant ring of corallites proximally, from which free branches arise; individual corallites, trumpet- or pipe-shaped, and in contact only at point of origin, each giving rise to another by lateral increase through the wall of the expanded calice; each has a thick peripheral stereozone of laminar, sometimes reticulated, sclerenchyme; neither tabulae nor septal spines are seen in the narrow lumen, but longitudinal (?septal) ridges may appear in the calices. (Hill and Smyth, 1938, p. 127.)

Genotype.—*Cladochonus tenuicollis* McCoy, 1847.

Occurrence.—Hill and Smyth (1938, p. 128) give the occurrence as upper Middle Devonian and Upper Devonian of North America and Germany; Lower Carboniferous of North America, western Europe, Russia, and eastern Australia; Middle and Upper Carboniferous of Russia; Permian of Western Australia, Timor, China, and Jugoslavia.

Remarks.—Many American species have been referred to *Monilopora* Nicholson and Etheridge, 1879, but Girty (1925), pointed out on erroneous ground that *Cladochonus* is a senior synonym of *Monilopora*. Hill and Smyth (1938, p. 125) arrived at the same conclusion but for different reasons. *Pyrgia* Milne-Edwards and Haime, 1851, is a junior subjective synonym of *Cladochonus*. For the arguments regarding the status of these genera, see Girty (1925) and Hill and Smyth (1938). *Monilipora* is an erroneous emendation of *Monilopora*.

Cladochonus Striatus Easton, n. sp.

Plate 13, figure 5; Plate 17, figures 4, 5

Externals.—Colonies of medium size, rather straight, new corallites budding from parent about midway on convex side, facing alternately in opposite directions, lying in one plane; three or four corallites connected by common canal, generally occur on partly overlapping crinoid stems; fronds arising from first circle of corallites, presumably extended directly away from crinoid stem; calyces oval; corallites curved, evenly expanding to calyx rim, with pronounced striae on epitheca.

Largest frond 35 mm in length; individual corallites about 5 mm long on convex side and 3 or 4 mm on concave side; calyces about 2.3 mm in diameter.

Comparison.—*C. striatus* differs from *C. beecheri* (Grabau) in being smaller, having more linear colonies, and in being striate.

Occurrence.—Locality 8.

Material.—Specimens studied, 12. Holotype and paratypes, University of Chicago Nos. 9678 and 9769, respectively.

Position Unknown

Coleophyllum? greeni Rowley

Plate 15, figures 1-4

Coleophyllum? greeni Rowley, 1901, Am. Geologist, vol. 27, p. 352, pl. 28, figs. 53-56.

Description.—"This coral is elongated, curved and without septa (lamellae). The cup is shallow. The entire fossil is made up of a series of invaginated tabulae, as seen on the weathered specimens. The outer surface is comparatively smooth except near the calix where the edges of the tabulae remind one somewhat of Cystiphyllum." (Rowley, 1901, p. 352.)

Occurrence.—Locality 29.

Material.—Apparently two or more specimens were known to Rowley, but the writer understands they are not now available for study.

Remarks. — Rowley called this species "*Chonophyllum greenei*" in the explanation of the plate. The writer defers offering an opinion as to the taxonomic position of this species until the types or comparative material can be studied. The figures resemble stony bryozoa or *Syringopora* as much as they do *Coleophyllum* or *Chonophyllum*

PLATES AND EXPLANATIONS

EXPLANATION OF PLATE 3

FIGS. 1-3 *Metriophyllum deminutivum* Easton, n. sp.; × 7.5 . . . . p. 31

1, Longitudinal section; holotype; axial appearance results from slightly oblique section through axially fused septa; University of Cincinnati 24300.

2, Tangential section; paratype; not alternating carinae in early region but progressive apposition until yard-arm carinae occur in most advanced stage; University of Cincinnati 24301.

3, Transverse section, reversed, middle? ephebic stage; paratype; note small number of septa, two places where carinae have been cut parallel with septa, and somewhat tripartite counter septal arrangement; University of Cincinnati 24302.

FIGS. 4-6 *Rotiphyllum hians* Easton, n. sp. . . . . p. 33

4, Longitudinal section; paratype; × 5; note tabulae; University of Cincinnati 24304.

5, Transverse section, reversed, ephebic stage; paratype; × 5; note solid axial area, sparse tabulae, short cardinal septum and tripartite counter system; University of Cincinnati 24305.

6, Transverse section, reversed, neanic stage; holotype; × 7.5; cardinal and counter septa, in combination with others, form a median plate; University of Cincinnati 24303.

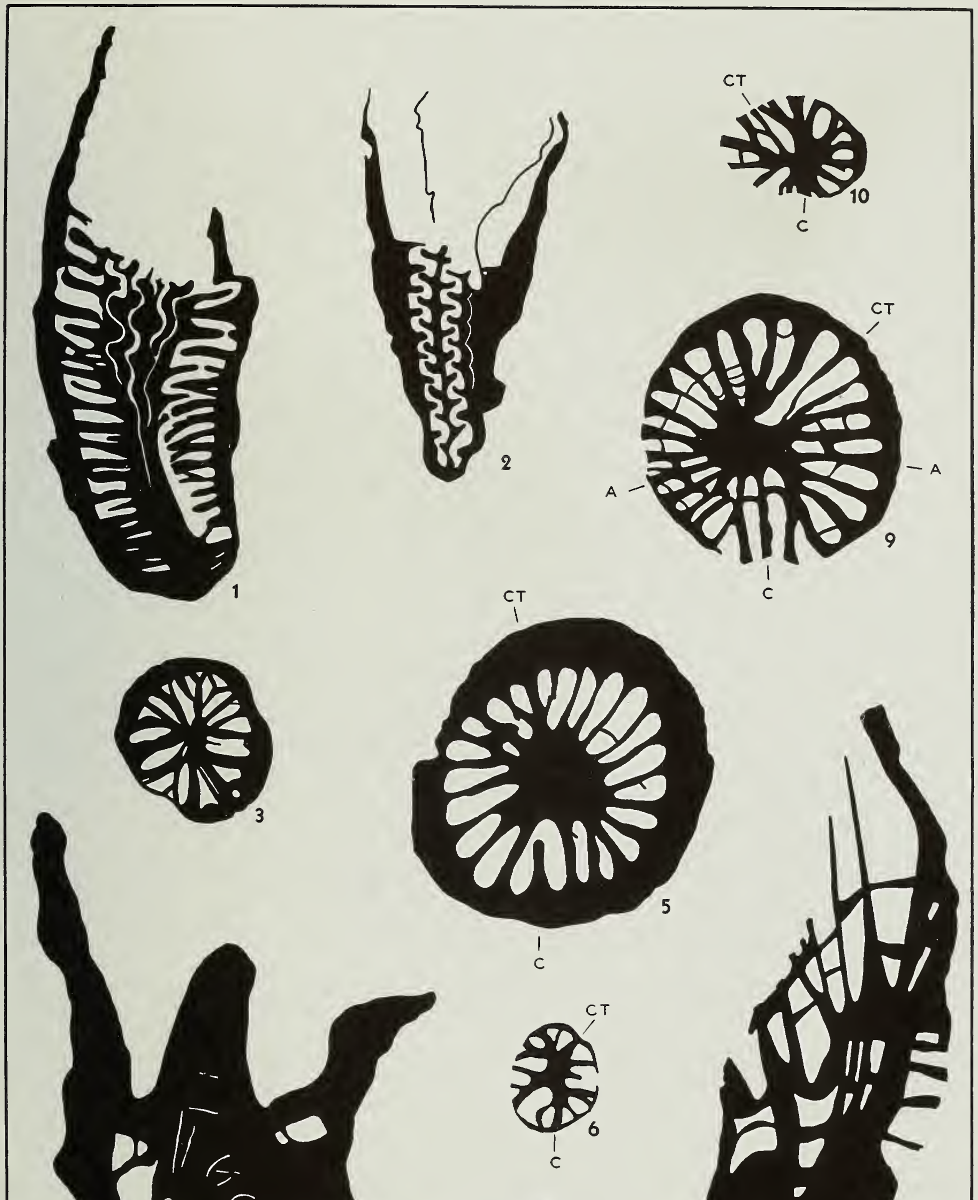
FIGS. 7-10 *Rotiphyllum calyculum* (Miller) emend. Easton; × 5 . . . . p. 32

7, Transverse section, late neanic stage; holotype; University of Cincinnati 3359.

8, Longitudinal section; paratype.

9, Transverse section, late ephebic stage; paratype; solid central area, counter fossula, and cardinal fossula are characteristic.

10, Transverse section, reversed, early ephebic stage; paratype; figs. 8, 9, 10 are University of Cincinnati 24307.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EXPLANATION OF PLATE 4

FIGS. 1-3 *Neozaphrentis tenella* (Miller); plesiotypes; × 5 . . . . p. 45

1, Transverse section, early ephebic stage; long thickened counter septum lying to one side of counter-cardinal plane, very short cardinal septum, and pinnate arrangement of septa in cardinal quadrants are characteristic; after Grove.

2, Transverse section, middle neanic stage; septa radially arranged, nearly reach center, and their fused axial edges form stereotheca; after Grove.

3, Transverse section, late ephebic stage; quadripartite septal grouping noteworthy; after Grove.

FIGS. 4-7 *Hapsiphyllum (Homalophyllites) calceolus* (White and Whitfield); plesiotypes . p. 43

4, Transverse section, late ephebic stage; × 5; very short cardinal septum in pronounced fossula, very thick epitheca and sparse tabulae are characteristic; circular cross-section is unusual; University of Cincinnati 24311.

5, Transverse section, late neanic stage; × 10; long bifid cardinal septum, sparse tabulae, and poorly defined stereotheca are noteworthy; epitheca eroded away.

6, Transverse section, early neanic stage; × 10; fused cardinal and counter septa is important feature; epitheca eroded away; figs. 5 and 6 are from same specimen.

7, Longitudinal section; × 5; thick epitheca with constrictions well shown on right side and arched tabulae are noteworthy; dark central areas are stereotheca; outlined white areas are possibly morphologic structures, possibly incidental replacement.

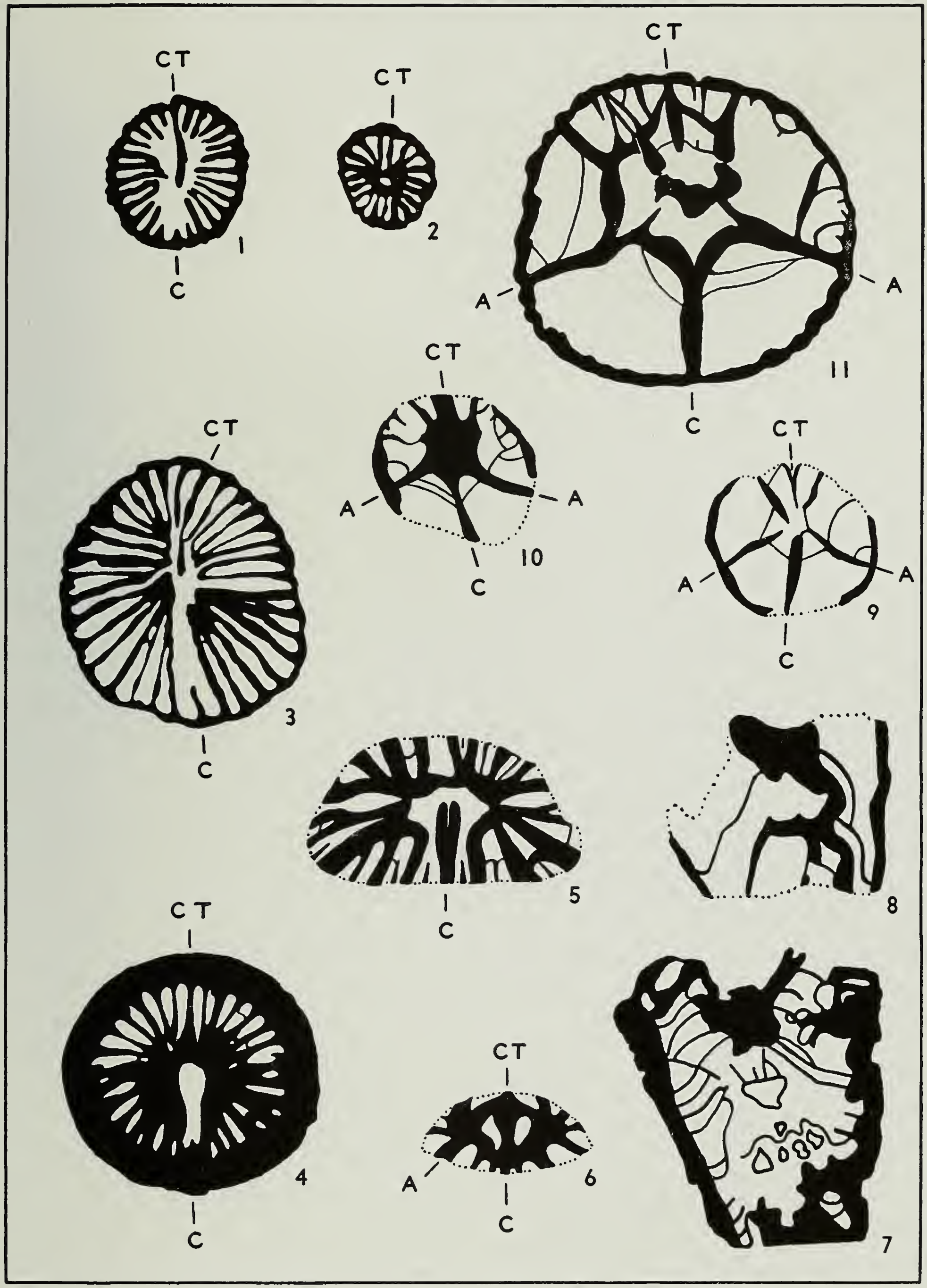
FIGS. 8-11 *Pseudocryptophyllum cavum* Easton, n. sp.; holotype; × 5 . . . . p. 34

8, Longitudinal section; tabulae recurved at periphery, steeply arched, depressed and thickened axially.

9, Transverse section, early ephebic stage; cardinal septum thick, counter septum thin; no secondary septa present.

10, Transverse section, late neanic stage; cardinal septum thinner than counter septum; secondary septa retreating from axis; dark axial area is where plane of section cut tabula.

11, Transverse section, late ephebic stage; meta-septa added in counter quadrants; epitheca irregular at positions of interseptal ridges and septal grooves; note swollen tips of counter-laterals.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EXPLANATION OF PLATE 5

FIGS. 1-4 *Meniscophyllum minutum* Simpson; plesiotypes; University of Cincinnati No. 23243; $\times$ 5 . . . . p. 46

1, Transverse section, late ephebic stage; all but two septa completely fused into ring.

2, Transverse section, reversed, late neanic stage; all septa extend to center.

3, Longitudinal section; note axial tabulae.

4, Transverse section, reversed, early ephebic stage; cardinal fossula becoming apparent.

FIGS. 5-9 *Vesiculophyllum sedaliense;* plesiotype; Illinois State Geological Survey No. 3506 . p. 52

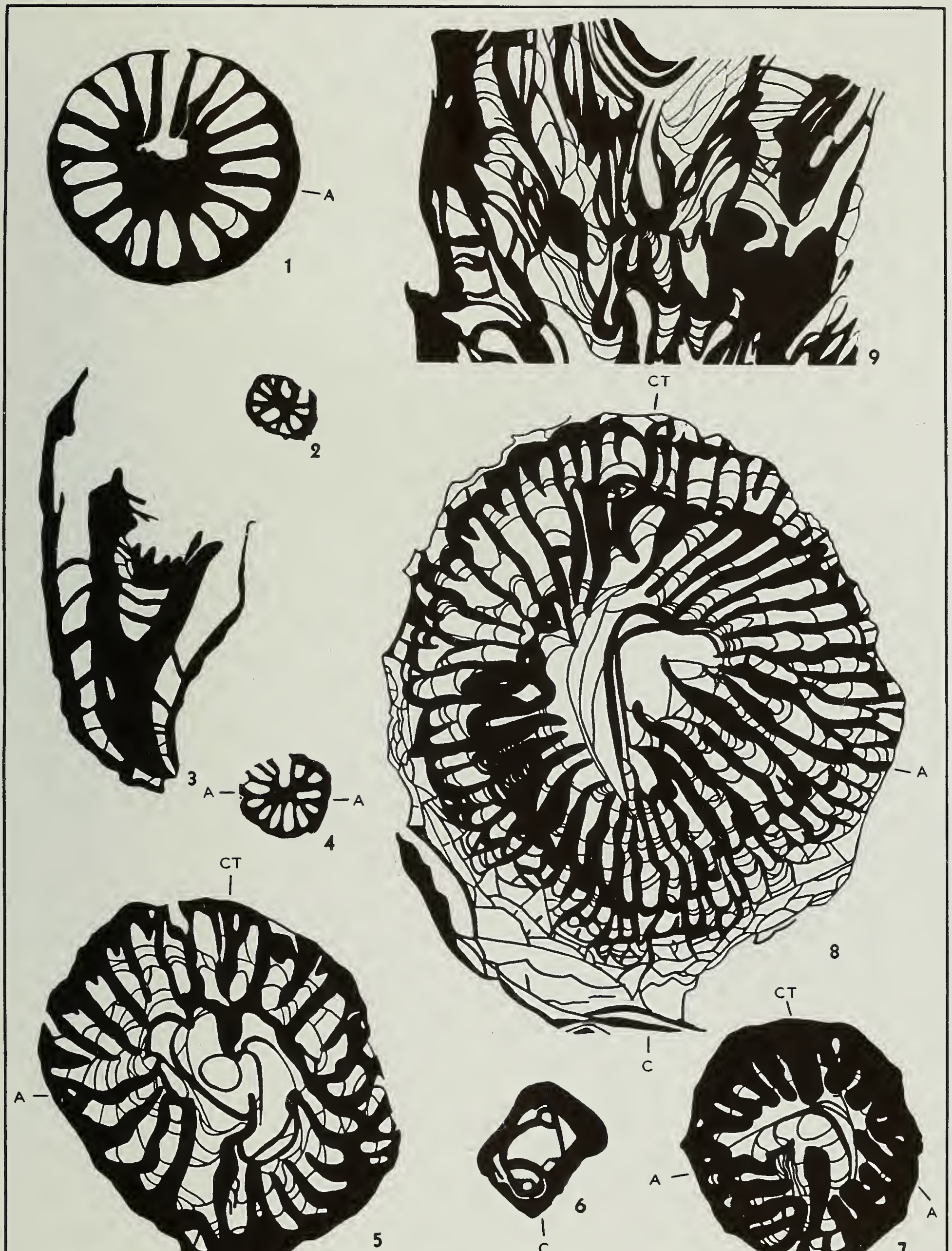
5, Transverse section, early ephebic stage; plesiotype; $\times$ 5; secondary septa are still short; all septa rather thin, but those in the cardinal quadrants are somewhat thickened; no dissepiments.

6, Transverse section, very early neanic stage; plesiotype; $\times$ 5; tabulae prominent and septa rudimentary.

7, Transverse section, late neanic stage; plesiotype; $\times$ 5; long thick cardinal septum, thick counter septum, pinnate septal pattern in cardinal and counter quadrants, and thickened septa are noteworthy.

8, Transverse section, late ephebic stage; plesiotype; $\times$ 5; aside from following orthogenetic trend shown in fig. 5, the lonsdaleoid dissepiments are the only additional feature.

9, Longitudinal section, ephebic stage before addition of dissepiments; plesiotype; $\times$ 2.5; contorted septa are cut several places in the section so that tabulae appear to be discontinuous.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EXPLANATION OF PLATE 6

FIGS. 1-3 *Clinophyllum chouteauense* Miller; plesiotypes; × 5 . . . . p. 47

1, Transverse section, early ephebic stage; note single secondary septum on either side of counter septum; after Grove.

2, Transverse section, slightly more advanced than *1;* tabular intersection across axial region; counter septum very thick; cardinal septum thicker than nearby meta-septa; after Grove.

3, Longitudinal section; plesiotype; note presence of some thickened tabulae.

FIGS. 4-6 *Clinophyllum excavatum* Easton, n. sp.; holotype; University of Missouri No. 1150; × 5 . . . . p. 47

4, Transverse section, late neanic stage; some septa reach center at transected tabula (dark area).

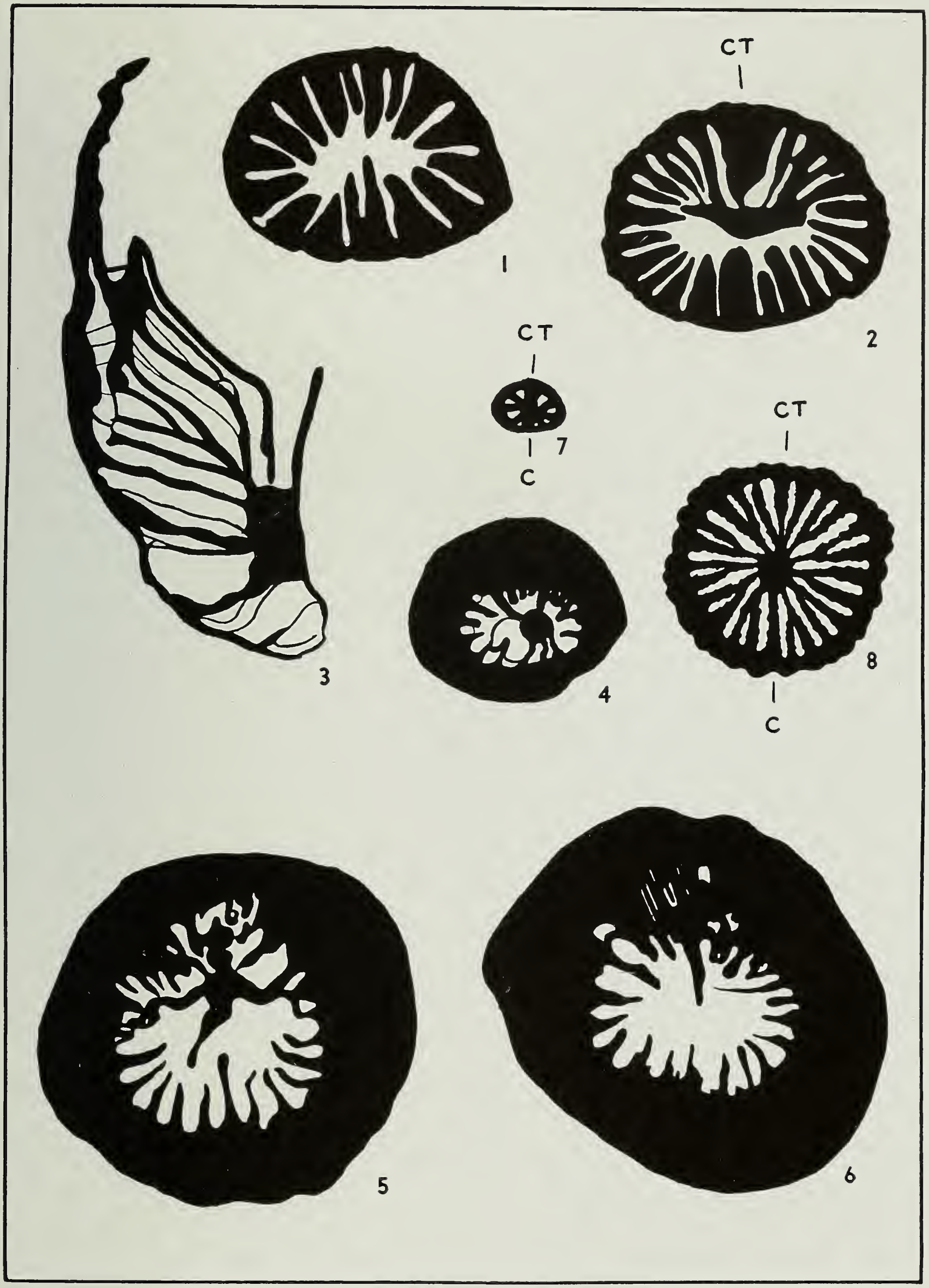
5, Transverse section, middle ephebic stage; counter septum thickened; cardinal septum somewhat longer than neighboring meta-septa.

6, Transverse section, late ephebic stage; counter septum longest, others about of equal length, though two slightly longer septa may be alar septa; extraordinarily thick epitheca is characteristic.

FIGS. 7, 8 *Cyathaxonia tantilla* (Miller); University of Missouri collection; × 15 . . . . p. 30

7, Transverse section, early neanic stage.

8, Transverse section, late ephebic stage; note carinate septa.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EXPLANATION OF PLATE 7

FIGS. 1-5 *Koninckophyllum glabrum* Keyes; plesiotypes . . . . p. 51

1, Transverse section, ephebic stage; × 2.5; median plate with transected tabulae and tabellae bordering it are characteristic; note septal crests near axis.

2, Longitudinal section between figs. 1 and 2; × 2.5; note interrupted median plate.

3, Transverse section, late ephebic or possible gerontic stage; × 2.5; note absence of median plate or upwarped tabulae and tabellae axially and also withdrawal of septa to periphery; figs. 1-3 are from same specimen.

4, Transverse section, early ephebic stage; × 5; note that many septa touch the thick median plate.

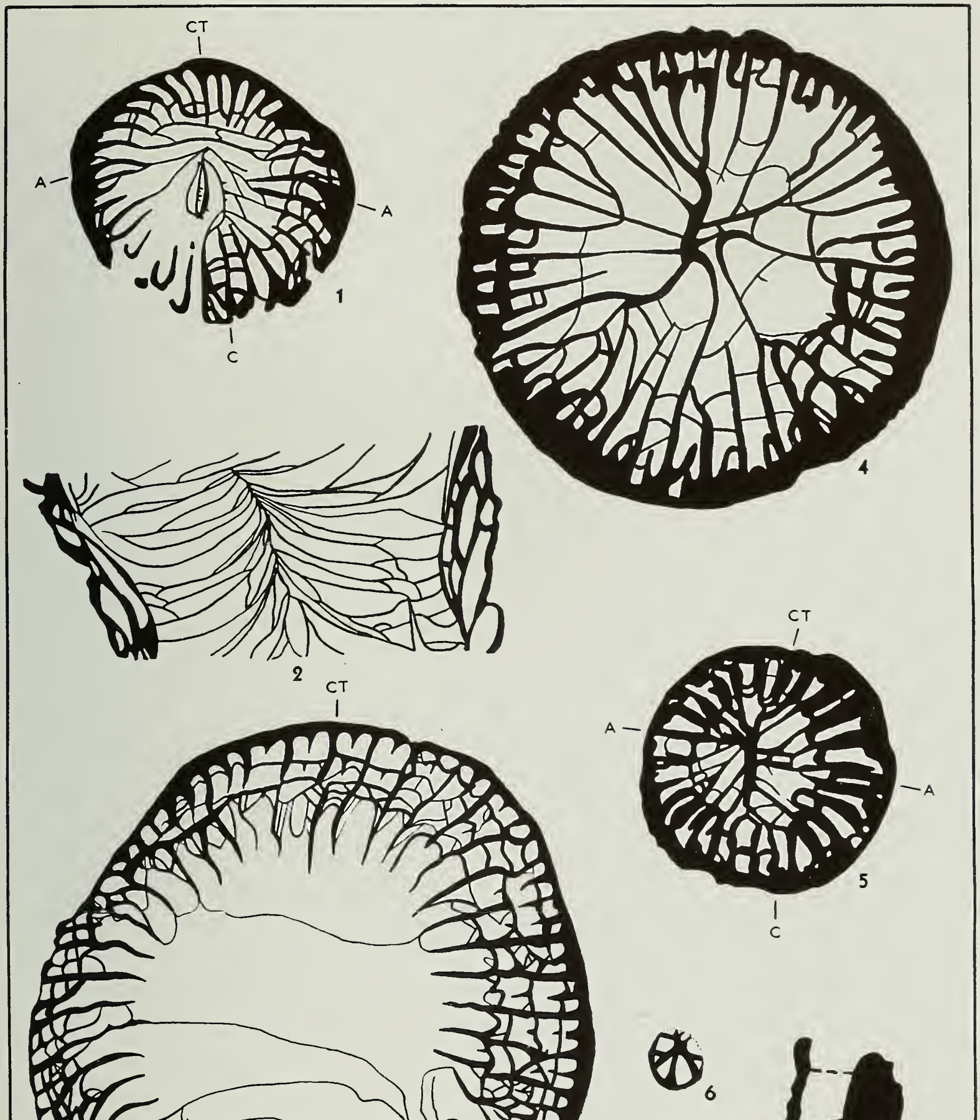
5, Transverse section, very early ephebic or late neanic stage; × 5; most septa touch the very thick median plate; figs. 4 and 5 are from one specimen.

FIGS. 6-8 *Hapsiphyllum (Homalophyllites) pinnatus* Easton, n. sp. . . . . p. 44

6, Transverse section, early neanic stage; × 5; note lack of tabulae.

7, Transverse section; ephebic stage; ideotype; × 2.5; fewer septa than typically; *6, 7,* are Illinois Geological Survey No. 3502.

8, Longitudinal section; paratype; University of Cincinnati No. 3360a; note tabulae and solid central area where septa join (open space represents material not preserved in specimen).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EXPLANATION OF PLATE 8

Triplophyllites palmatus Easton, n. sp.; transverse sections; × 5; Illinois State Geological Survey specimens . . . . p. 35

1, Late ephebic stage; paratype; No. 3520.

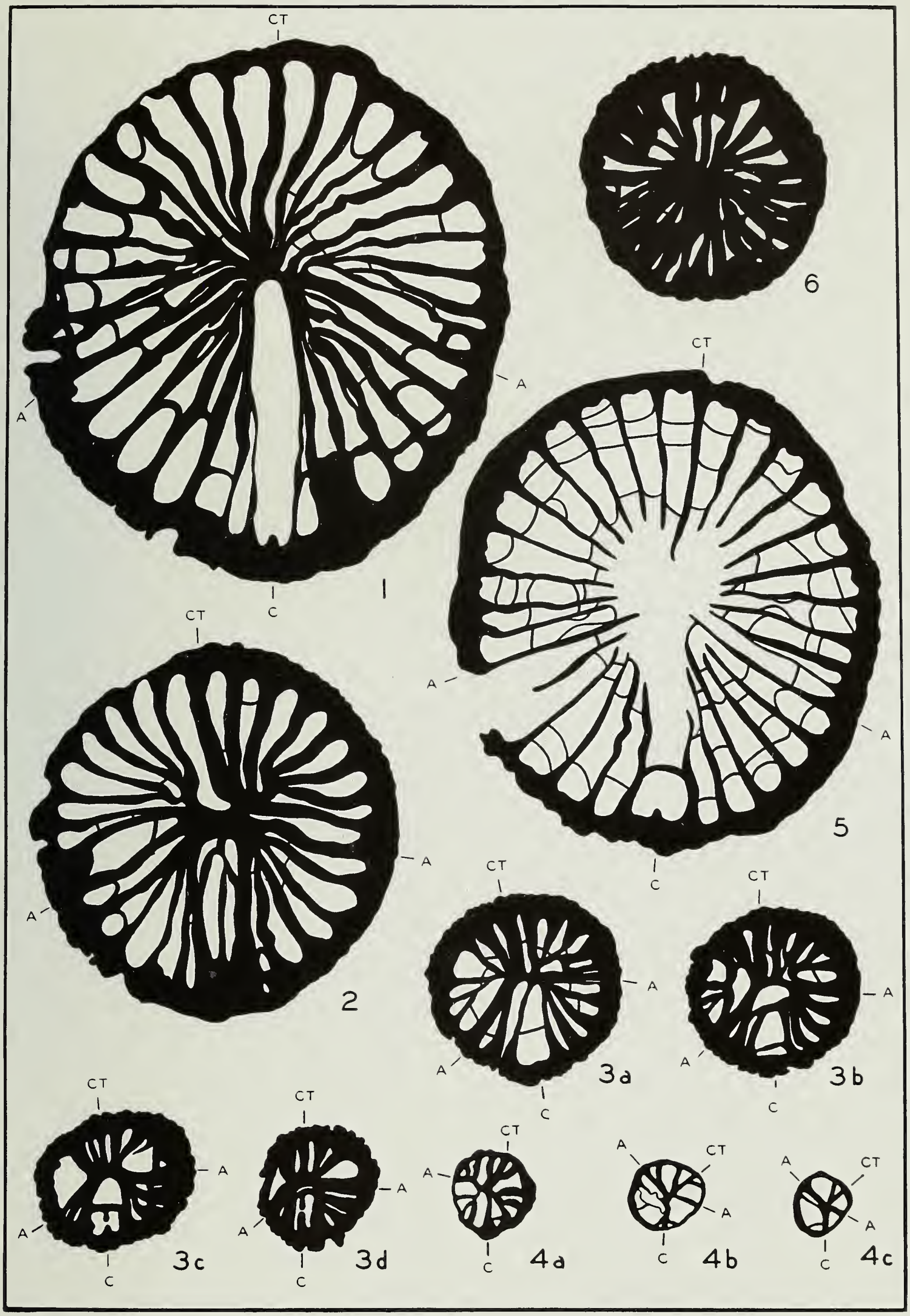
2, Middle ephebic stage; paratype; the long septum occupying the cardinal fossula is a metaseptum and the cardinal septum is masked by stereoplasm to the right of the metaseptum; No. 3521.

3a-3d, Serial sections of a specimen showing changes in progressively younger early ephebic stages; paratype, destroyed; the retreat of the septa in the counter quadrants is probably a peculiarity and is not of specific value; the interrupted cardinal septum is caused by its having an apical sag midway in its length.

4a-4c, Serial sections in very early ephebic and late neanic stages; paratype, destroyed; the reason for the abnormal development of what appears to be septa in the lower left portions of the figures is not known, but is probably related to twisting of the specimen.

5, Section in very late ephebic stage, just above the base of the calyx; paratype; reversed; No. 3522.

6, Ephebic stage showing excessive septal dilation with loculi almost filled with stereoplasm; even more extensive stereoplasmic thickening is common, but in either case the septal distribution can only be determined if the median lines of the septa happen to be clearly preserved; paratype; reversed; No. 3523.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EXPLANATION OF PLATE 9

FIGS. 1, 2 *Triplophyllites centralis* (Milne-Edwards and Haime); plesiotypes; × 5 . . . p. 39

1, Transverse section, ephebic stage; cardinal septum short; septa more radial in arrangement; alar fossula barely discernable; septa of counter quadrants withdrawn from central area; after Grove.

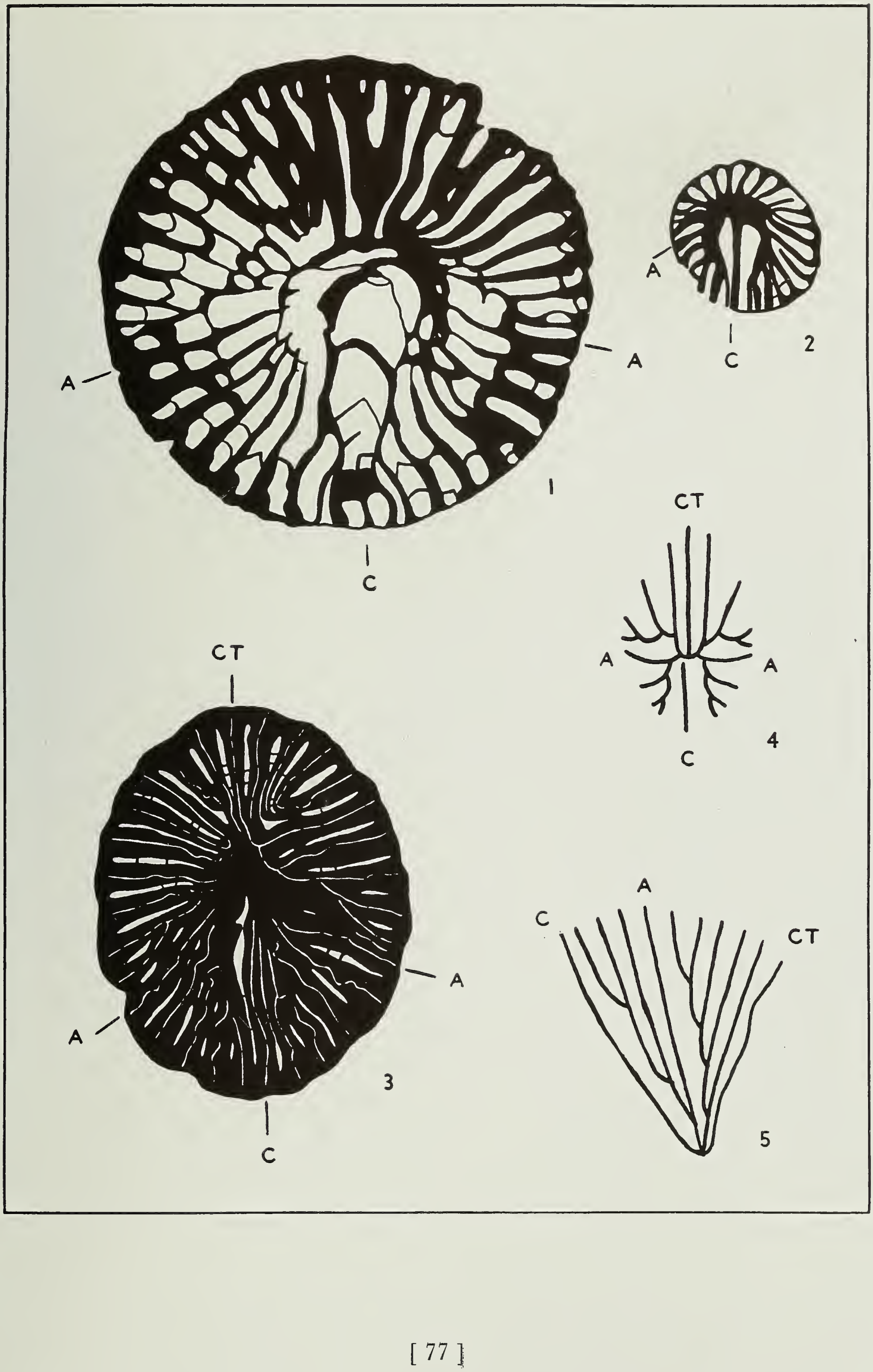
2, Transverse section, neanic stage; long thickened cardinal septum extends to stereotheca; septa of cardinal quadrants extend to wall; septa of counter quadrants abut against alar septa; dissepiments sparse; after Grove.

FIGS. 3-5 *Triplophyllites cliffordanus* (Milne-Edwards and Haime); plesiotypes; × 5 . . . p. 39

3, Transverse section, ephebic stage; section ovate, cardinal septum long; median lines of septa shown because of obscuring effect of stereoplasmic thickening of septa; State University of Iowa No. 9902.

4, Pattern of septal grooves as seen in three dimensions when looking down upon apex of corallite.

5, Pattern of septal grooves when seen from side; *4* and *5* are from the same specimen: State University of Iowa No. 9902.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EXPLANATION OF PLATE 10

FIGS. 1-7 *Triplophyllites exiguus* (Miller); plesiotypes . . . . p. 40

1, Transverse section, late ephebic stage; × 5; cardinal septum very short, other majors thin, curved, tending to be withdrawn from center; minor septa short; University of Chicago No. 31633D.

2, Transverse section, ephebic stage; × 10; detail of dissepiments.

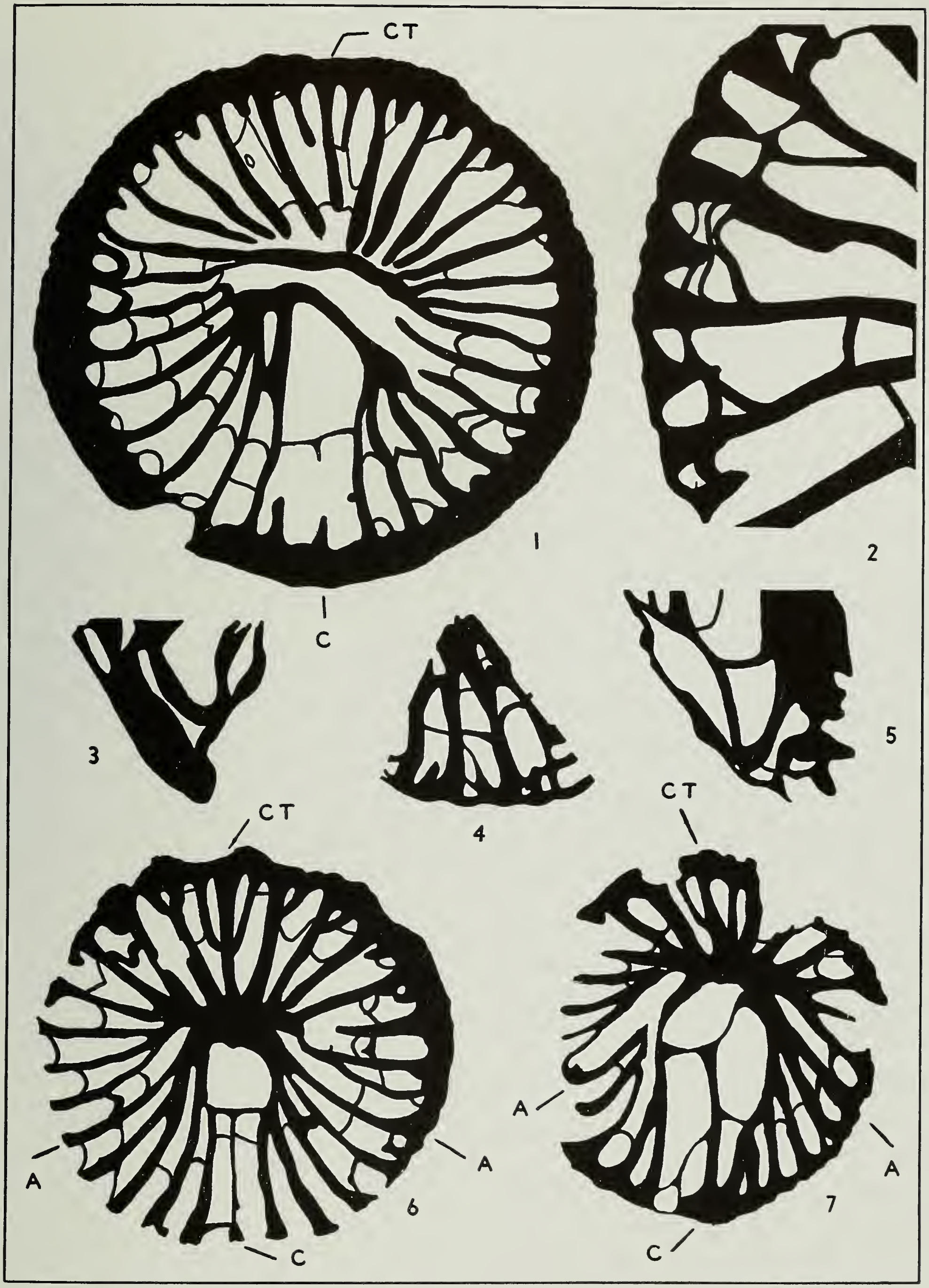
3, Longitudinal section; × 5; dissepiment shown in upper right portion.

4, Transverse section, ephebic stage; × 5; dissepiments shown along bottom.

5, Longitudinal section; × 5; dissepiments shown in left side; the top edges of *3* and *5* fit against the left and right edges of *4* so that the appearance of the dissepiments in transverse and longitudinal section can be seen; *2-5* are University of Chicago No. 31633B.

6, Transverse section, early ephebic stage; × 5; septa radial in counter quadrants, pinnate in cardinal quadrants; alar fossulae pronounced; secondary septa present locally; University of Chicago No. 31633E.

7, Transverse section, late neanic stage; × 5; cardinal septum long; cardinal fossula large; alar fossulae prominent; secondary septa lacking; University of Chicago No. 31632.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EXPLANATION OF PLATE 11

Figs. 1, 2 *Triplophyllum terebratum* (Hall) ; topotype ; American Museum of Natural History 4094/1 ; × 2.5 . . . . p. 38

1, Transverse section, late ephebic stage ; dissepiments densely packed, septa long, thin, many reaching axis ; fossulae indistinct or not developed.

2, Transverse section, late neanic or early ephebic stage ; twisting of septa and prominent cardinal fossula are characteristic.

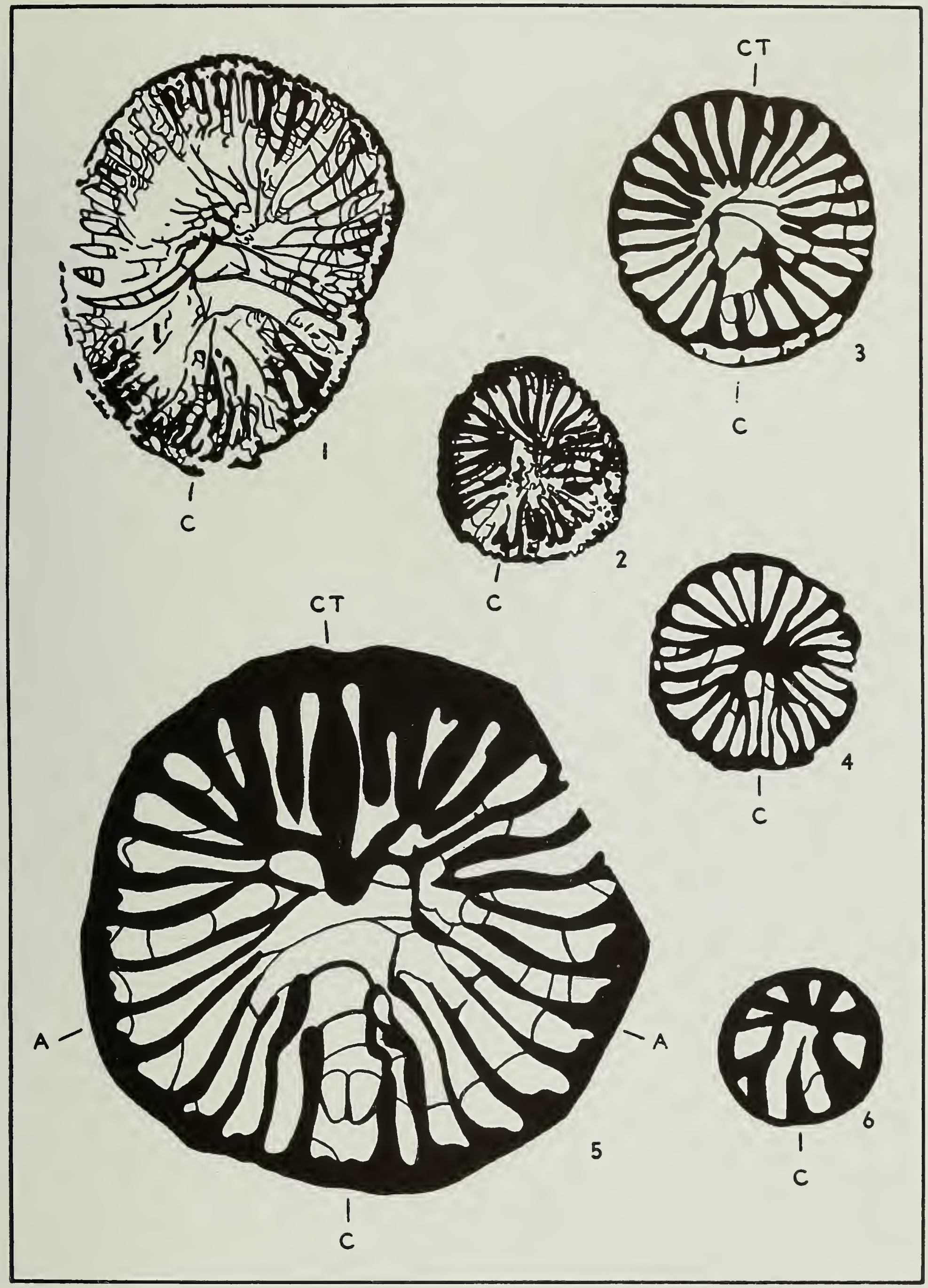
Figs. 3-6 *Triplophyllites ida* (Winchell) emend. Easton ; × 5 . . . . p. 41

3, Transverse section, late ephebic stage ; hypotype ; septa radially arranged, thick, and not numerous ; alar fossulae absent ; after Grove.

4, Transverse section, early ephebic stage ; hypotype ; septa remain in four groups, even at this stage ; after Grove.

5, Transverse section, reversed, middle ephebic stage ; paratype ; long thick counter septum, indistinct alar fossulae, and swollen axial ends of some septa are characteristic ; University of Michigan No. 23237.

6, Transverse section, reversed, early neanic stage ; plesiotype ; radially arranged septa in counter quadrants ; long cardinal and alar septa and pronounced alar pseudofossulae are noteworthy ; Illinois Geological Survey No. 3501.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EXPLANATION OF PLATE 12

FIGS. 1-3 *Caninia corniculum* (Miller) emend. Easton; plesiotypes; × 5 . . . . p. 49

1, Transverse section, ephebic stage; thickened counter septa are characteristic.

2, Transverse section, late ephebic stage; note thickened counter septa and general withdrawal of all septa from center (amplexoid retreat).

3, Longitudinal section showing steeply tilted tabulae; same specimen as *1.*

FIGS. 4-8 *Amplexus rockfordensis* Miller and Gurley; plesiotypes; × 2.5 . . . . . . p. 48

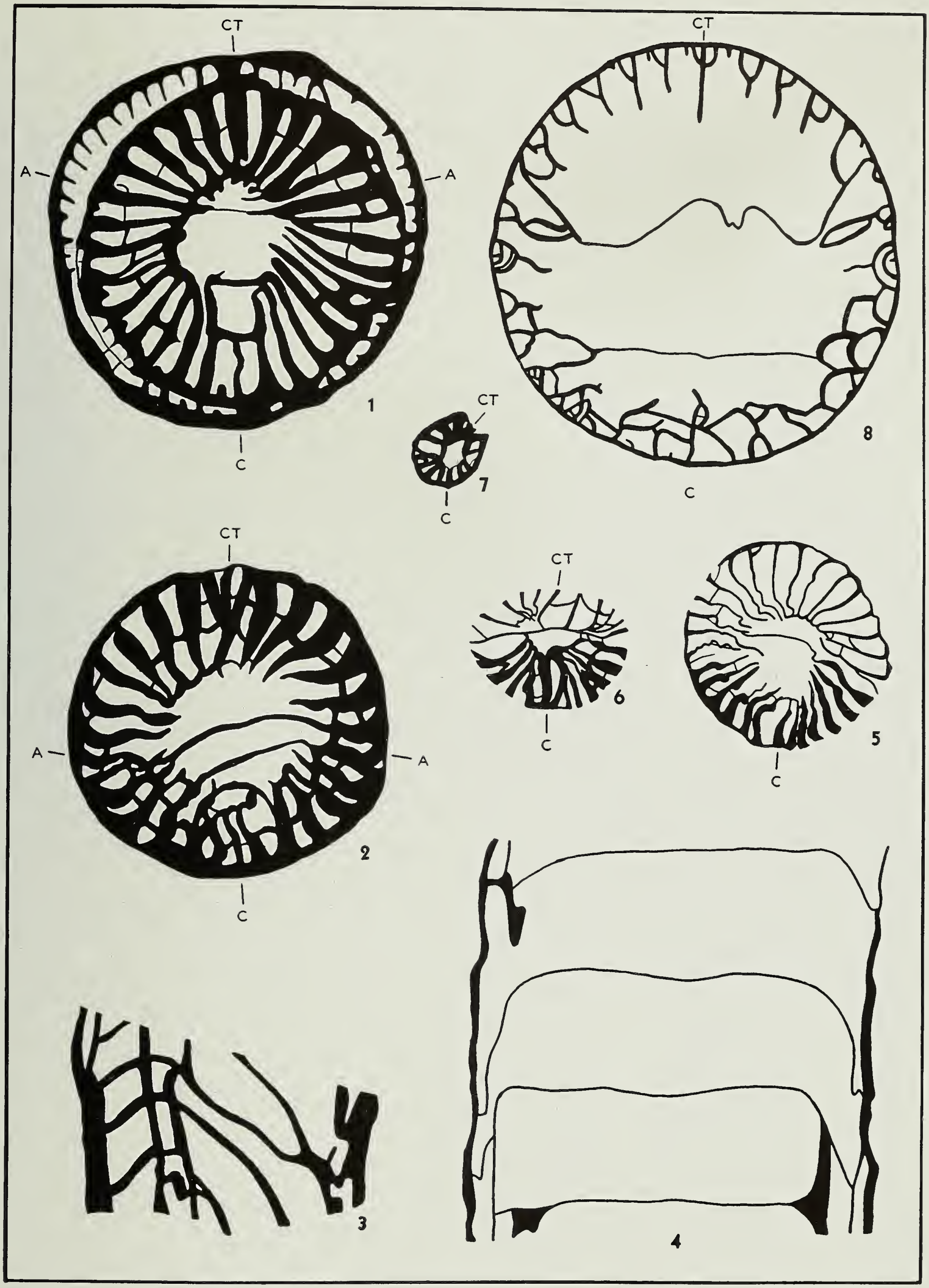
4, Longitudinal section showing wide spacing of tabulae; University of Michigan No. 23234.

5, Transverse section, late ephebic stage; thickened septa of cardinal quadrants and amplexoid retreat are characteristic; University of Michigan No. 23233.

6, Transverse section, reversed, early ephebic stage; thickened septa of cardinal quadrants, extra-thickened cardinal septum, and extent of septa almost to center are characteristic; University of Michigan No. 23233.

7, Transverse section, reversed, neanic stage; all septa are thick; University of Michigan No. 23236.

8, Transverse section, reversed, very late ephebic stage; very short septa are characteristic; very short minor septa present; University of Michigan No. 23234.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EXPLANATION OF PLATE 13

FIGS. 1-3 *Lithostrotion microstylum* White; plesiotype; × 5 . . . . p. 53

1, Transverse section of portions of three corallites; the circular axial column touched only by long septa and the vesicular area between corallites (aphroid) are characteristic.

2, Longitudinal section of one corallite; central dark areas are axial column, septa and thickened tabulae; other dark areas are interrupted epitheca separating adjacent corallites; the raised rim around the axial column is typical.

3, Longitudinal section of two corallites; good epitheca is shown at extreme right; axial column of right polyp shows tabellae and septal lamellae.

FIG. 4 *Favosites divergens* White and Whitfield; holotype; × 2.5 . . . . p. 54

Longitudinal section; the sparse mural pores and the occasional oblique tabulae are characteristic.

FIG. 5 *Cladochonus striatus* Easton; paratype; × 2.5 . . . . p. 62

Section through three corallites encrusting crinoid stem (stippled) which has grown over the coral at two places; note visceral connection between corallites.

FIG. 6 *Favosites? mancus* Winchell; holotype; × 5 . . . . p. 54

Longitudinal section showing sparse mural pores and tabulae.

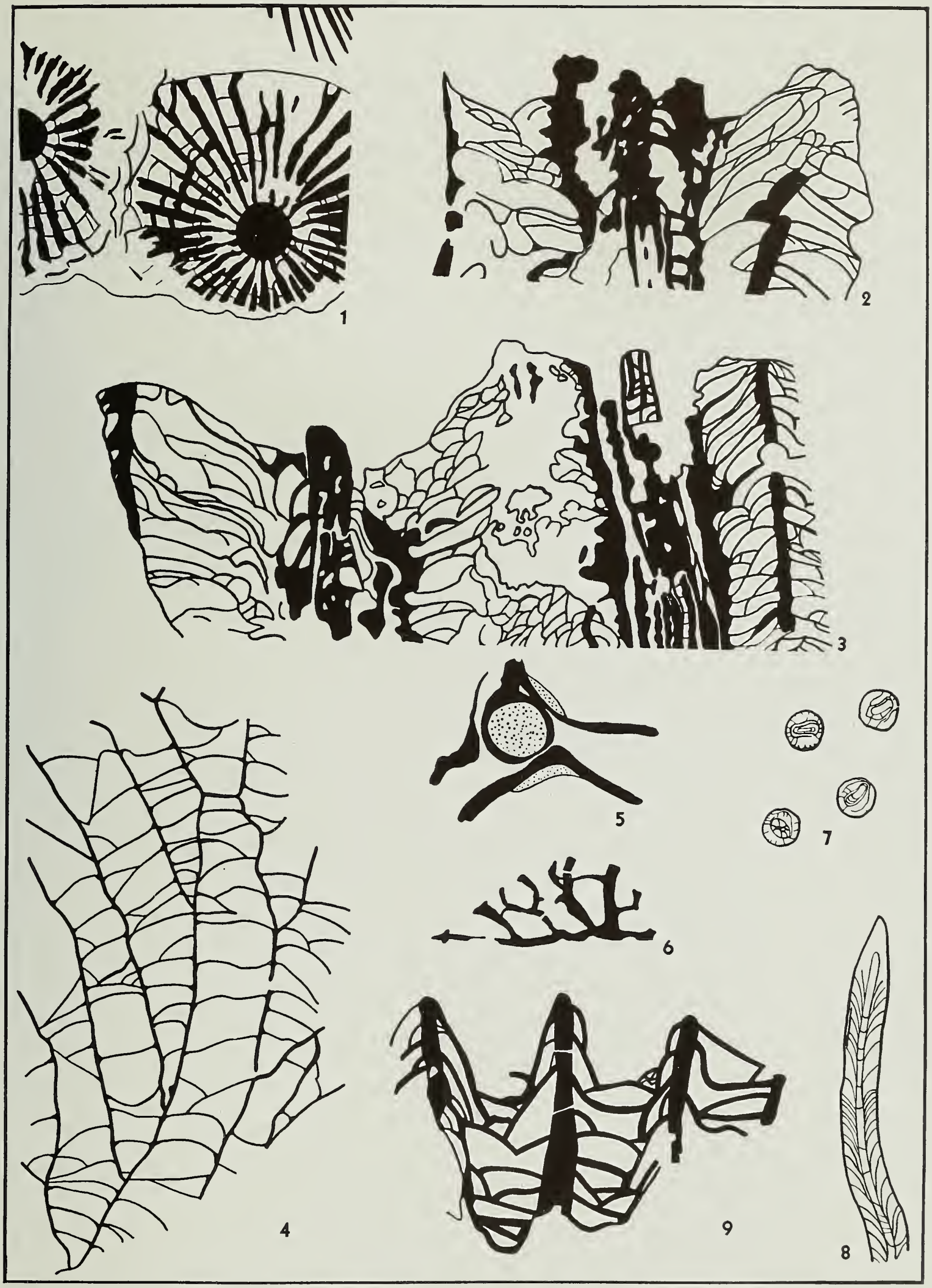
FIGS. 7, 8 *Syringopora harveyi* White; plesiotype; × 5 . . . . p. 61

7, Transverse section showing spacing of corallites, as well as internal structure.

8, Longitudinal section showing portion of one septum near upper left edge of section.

FIG. 9 *Pleurodictyum expansum* (White); holotype; × 2.5 . . . . p. 55

Longitudinal section; steeply tilted tabulae in calyx are characteristic.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EXPLANATION OF PLATE 14

FIGS. 1, 2 *Cleistopora typa* (Winchell) emend. Easton; holotype; × 5 . . . . p. 59

1, Longitudinal section; reticulate structure is in somewhat horizontal rows and the open portions contain thin diaphragms; corallite walls perforate and not well differentiated; corallites flat-floored.

2, Transverse section near surface; general hexagonal shape of corallite is observable.

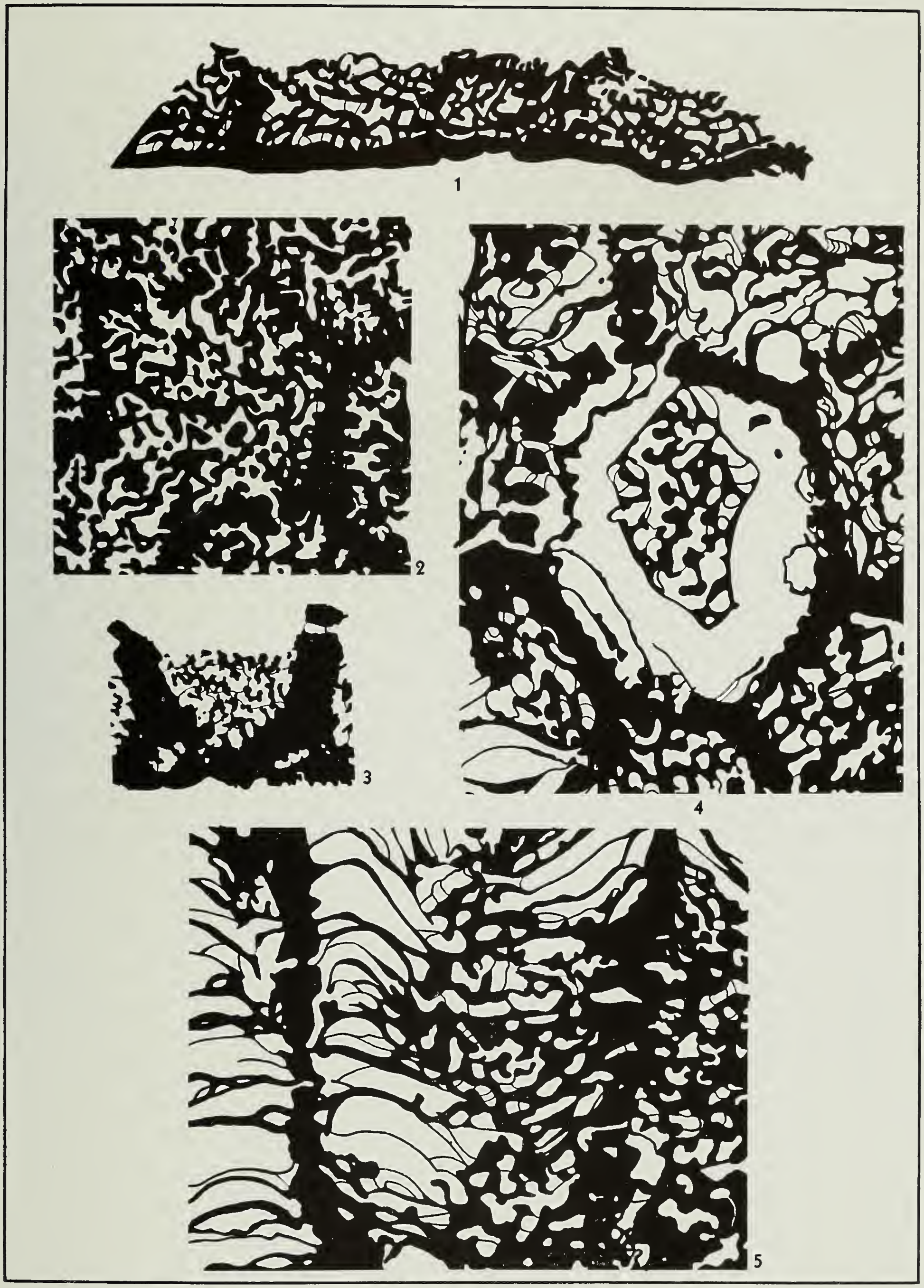
FIG. 3 *Cleistopora geometrica* (Milne-Edwards and Haime); plesiotype; × 6 . . . . . p. 57

Longitudinal section; well-defined walls and concave corallite floor are noteworthy; genotype; figured for comparison (after Smyth).

FIGS. 4, 5 *Cleistopora ramosa* (Rowley); plesiotype; × 5 . . . . p. 58

4, Longitudinal section; well defined corallite wall on left, poorly defined wall on right; merging of tabulae into reticulate structure is characteristic.

5, Transverse section midway in corallum; central reticulate mass is almost surrounded by tabulae; note granular upper surface of tabulae in lower left center.



EXPLANATION OF PLATE 15

FIGS. 1-4 *Coleophyllum? greeni* Rowley; × 1 . . . . p. 62

Side views; from Rowley.

FIG. 5 *Cleistopora procera* (Rowley); × 1 . . . . p. 58

Side view of colony; from Rowley.

FIG. 6 *Cleistopora ramosa* (Rowley); holotype; × 1 . . . . p. 58

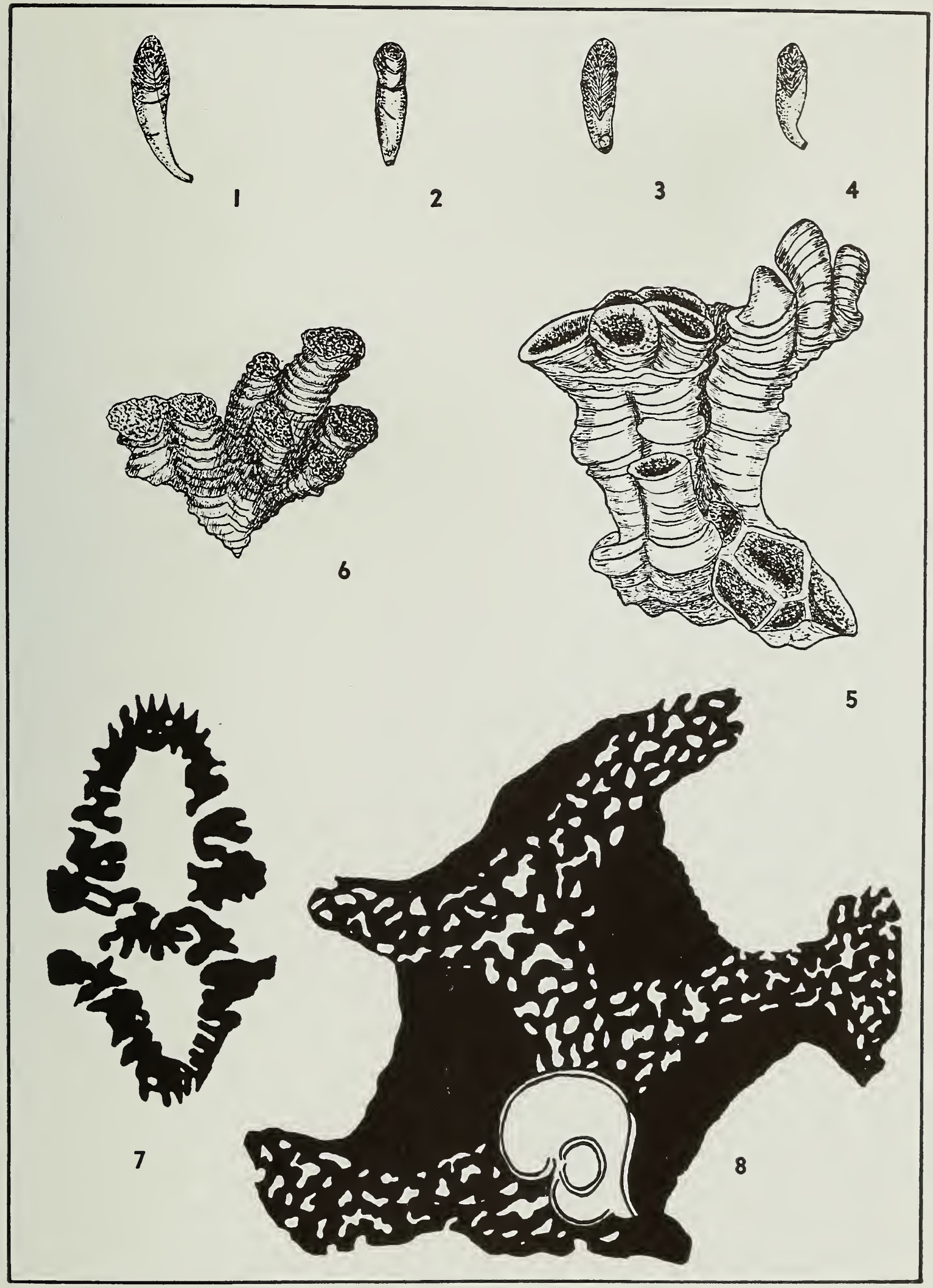
Side view of colony; from Rowley.

FIG. 7 *Palaeacis humilis* Hinde; paratype; × 5 . . . . p. 56

Cross-section of a colony of four corallites, showing the mural pores characteristic of the genus; after Hinde.

FIG. 8 *Microcyathus cyclostoma* (Phillips); × 8 . . . . p. 60

Cross-section of a colony of three or four corallites attached to a gastropod shell; dense tissue at the floor of the calyces and reticulate tissue within the walls are characteristic of the genus; after Etheridge and Nicholson.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EXPLANATION OF PLATE 16

FIGS. 1-4 *Cleistopora typa* (Winchell) emend. Easton; × 1; original figured cotypes of *Leptopora gorbyi* Miller; University of Cincinnati No. 3273 . . . . p. 59

1, Lower surface. *2,* Upper surface of same specimen. *3,* Upper surface. *4,* Lower surface.

FIG. 5 *Cleistopora sp.;* × 1; plastocotype of *L. typa* Winchell . . . . p. 60

Upper surface, showing small corallites.

FIGS. 6-8 *Cyathaxonia hians* Easton, n. sp.; × 1 . . . . p. 33

6, Side view.
7, Calyx; holotype; University of Cincinnati No. 24303.
8, Calyx; paratype; University of Cincinnati No. 24304.

FIGS. 9, 10 *Microcyclus blairi* Miller; × 1 . . . . p. 29

9, Holotype; University of Cincinnati No. 3998.
10, Paratype; University of Cincinnati No. 4000.

FIGS. 11-15 *Hapsiphyllum (Homalophyllites) pinnatus* Easton, n. sp. . . . . p. 44

11, Side view.
12, Calyx of same specimen; holotype; University of Cincinnati No. 24314.
13, Calyx; × 2; plesiotype; University of Cincinnati No. 24311.
14, 15, Calyces; paratypes; University of Cincinnati No. 24310.

FIGS. 16, 17 *Cyathaxonia tantilla* (Miller) emend. Easton; × 2 . . . . p. 30

16, Side view; holotype; University of Cincinnati No. 3940.
17, Calyx; paratype; University of Cincinnati No. 24404.

FIG. 18 *Microcyathus enormis* (Meek and Worthen); × 1; holotype; side view . . . . . p. 60

FIG. 19 *Palaeacis conica* Easton, n. sp.; holotype; × 2 . . . . p. 56

Side view; University of Cincinnati No. 24319.

FIGS. 20-22 *Meniscophyllum minutum* Simpson; × 1 . . . . p. 46

20, Longitudinal section; paratype; New York State Museum No. 3540/1.
21, Transverse section; holotype; New York State Museum No. 3540/2.
22, Transverse section; paratype; New York State Museum No. 3540/3.
Photographs by New York State Museum.

FIGS. 23-25 *Hapsiphyllum (Homalophyllites) calceolus* (White and Whitfield); × 1 . . . p. 43

23, Side view.
24, 25, Calical views; plesiotypes; American Museum of Natural History No. 6365/3.

FIGS. 26-30 *Neozaphrentis tenella* (Miller) emend. Easton; × 1 . . . . p. 45

26, Side view.
27, Calyx of same specimen; holotype; University of Cincinnati No. 3360.
28-30, Calyces; paratypes; University of Cincinnati No. 3360a.

FIG. 31 *Pseudocryptophyllum cavum* Easton, n. gen. and n. sp.; × 1 . . . . p. 34

Holotype; side view; University of Missouri not numbered.

FIGS. 32, 33 *Rotiphyllum calyculum* (Miller) emend. Easton; × 1; holotype; University of Cincinnati No. 3359 . . . . p. 32

32, Side view. *33,* Calyx.

FIGS. 34-38 *Clinophyllum chouteauense* (Miller); × 1 . . . . p. 47

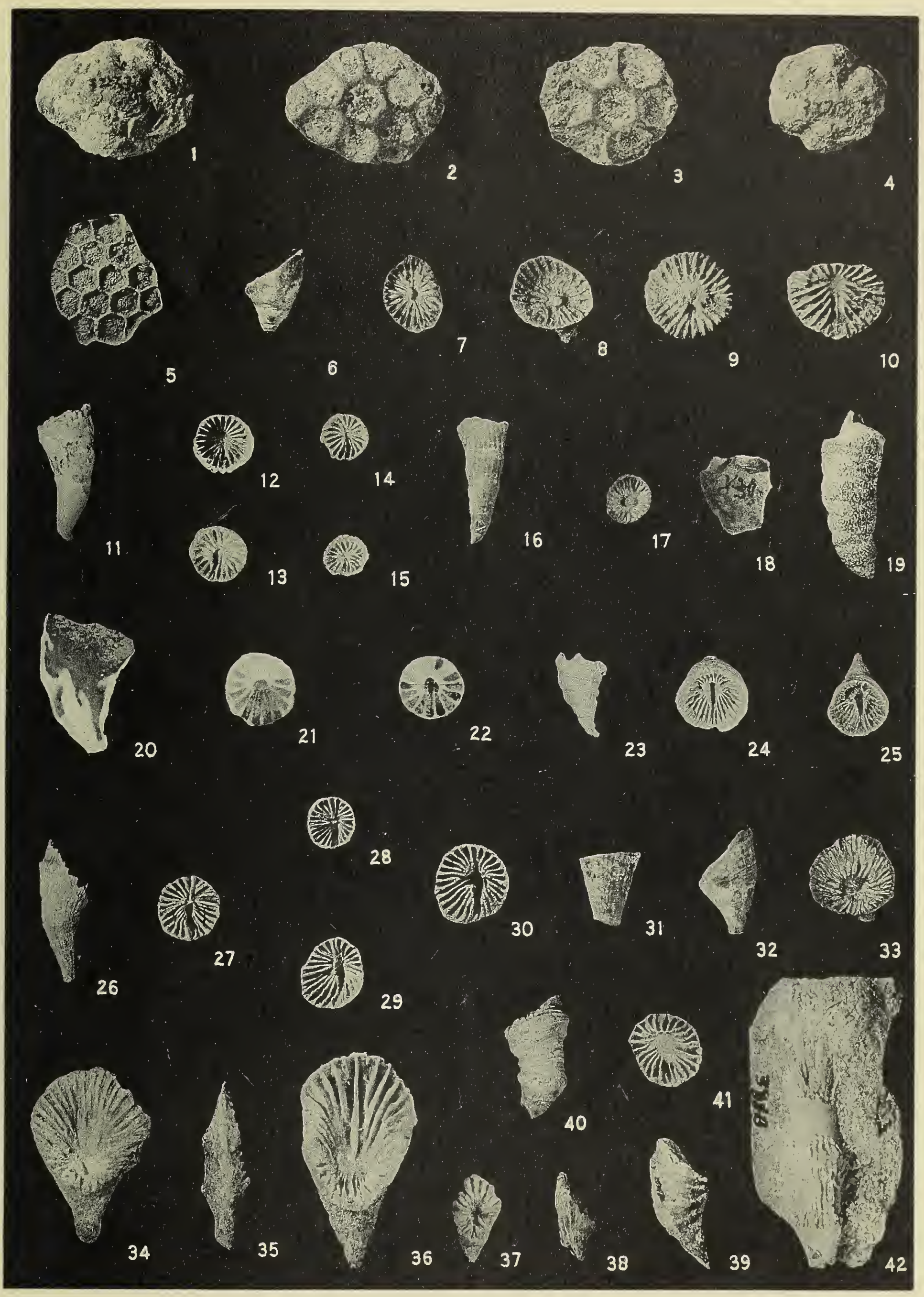
34, Side view showing oblique calyx.
35, Side view; holotype; University of Cincinnati No. 3916.
36, Side view showing oblique calyx of very clean specimen; paratype; University of Cincinnati No. 3917.
37, 38, Side views of ideotype; United States National Museum not numbered.

FIG. 39 *Clinophyllum excavatum* Easton, n. sp.; × 1 . . . . p. 47

Paratype; University of Cincinnati No. 24319; side view.

FIGS. 40-42 *Caninia corniculum* (Miller) emend. Easton; × 1 . . . . p. 49

40, Side view.
41, Calyx of same specimen; holotype; University of Cincinnati No. 2238.
42, Side view; original figured specimen of *A. blairi;* University of Cincinnati No. 3918.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EXPLANATION OF PLATE 17

FIG. 1 *Lithostrotion microstylum* White; plesiotype; × 1 . . . . p. 53

Portion of surface; University of Missouri No. 1357.

FIG. 2 *Pleurodictyum expansum* (White); holotype; × 1 . . . . p. 55

Portion of surface; University of Chicago No. 6687.

FIG. 3 *Favosites divergens* White and Whitfield; holotype; × 1 . . . . p. 54

Exterior of corallum; American Museum of Natural History No. 6363/1.

FIGS. 4, 5 *Cladochonus striatus* Easton, n. sp.; × 1 . . . . p. 62

4, Crinoid stem plate surrounded by four corallites; paratype; University of Chicago No. 9769.

5, Portion of free frond showing striate surface; holotype; University of Chicago No. 9678.

FIGS. 6, 7 *Triplophyllites ida* (Winchell) emend. Easton; × 1 . . . . p. 41

6, Exterior of large specimen; holotype; University of Michigan No. 5396.

7, Calyx of small, very young specimen; original figured specimens of *Z. exigua* Miller; University of Cincinnati No. 7391.

FIGS. 8, 9 *Cleistopora procera* (Rowley)?; plesiotype; × 1; University of Chicago No. 9765 p. 58

8, Lower surface.

9, Upper surface.

FIG. 10 *Koninckophyllum glabrum* (Keyes); plesiotype; × 1 . . . . p. 51

External view showing abrupt constrictions; University of Missouri No. 7209.

FIG. 11 *Aulopora?* sp.; × 1 . . . . p. 62

Two corallites separated from attached object; University of Chicago No. 47246.

FIG. 12 *Vesiculophyllum sedaliense* (White); plesiotype; × 1 . . . . p. 52

Exterior of rather small conical specimen; University of Missouri No. 359.

FIGS. 13, 14 Genus and species unidentified; × 1; University of Chicago No. 31591 . . . . p. 48

13, Calyx.

14, Side view.

FIG. 15 *Amplexus rockfordensis* Miller and Gurley; holotype; × 1 . . . . p. 48

Side view showing prominent spines; University of Chicago No. 6338.

FIGS. 16-18 *Triplophyllum terebratum* (Hall); × 1 . . . . p. 38

16, Calyx, topotype; American Museum of Natural History No. 4094/1.

17, Calyx.

18, View obliquely down into calyx; holotype; New York State Museum No. 3841/1; photographs by New York State Museum.

Illinois State Geological Survey
Report of Investigations No. 97

June, 1944